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Non-standard Forms of Naval Warfare: TACTICAL and TECHNOLOGICAL REQUIREMENTS

NORMAN FRIEDMAN

with contributions by

HERMAN KAHN & WILLIAM SCHNEIDER, JR.

HI-2351-RR

October 31, 1975

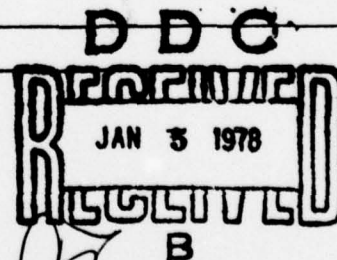


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By

Norman Friedman

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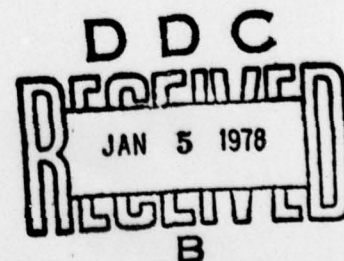
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I. EXECUTIVE SUMMARY AND CONCLUSIONS

This study attempts to identify technology required for the Navy to engage in forms of limited warfare not heretofore widely studied, but whose plausibility may increase significantly over the next quarter century. These conflicts may involve superpower conflict at sea (or perhaps their proxies) without engaging the Zone of Interior (ZI) of either participant. These conflicts may be characterized as politically limited with both psychological and military dimensions. The appearance of victory may be as important as its substance; an attribute of considerable importance in a multipolar environment.

The study explores the asymmetric character of U.S. and Soviet fleets, in their tactical employment, their capabilities, and the doctrine which drives their procurement and use. The asymmetries reveal certain important vulnerabilities for both sides.

Soviet centralization of command, control, and communication (C³), limited capacity for underway replenishment, limited magazine capacity, and a general incapacity for sustained naval conflict pushes their posture strongly toward a brief but intense naval conflict. In this regard there are notable parallels to its widely discussed "short war" posture for its ground forces.

The U.S., through differing requirements and experience, has deployed forces which are not always well suited to dealing with an opponent configured for a short naval war posture. A net assessment of these asymmetries raises some important conclusions for the R&D community:

- (1) The Soviet naval C³ structure is an important vulnerability which can be exploited through modest changes in technology.
- (2) Short warfare requires greater attention to survivability, and in particular, for making repairs without drydocking.
- (3) Modest changes in technology may permit high probabilities of kill (given a hit) against most classes of Soviet naval vessels with existing U.S. missiles (e.g. HARPOON). Improvement in lethality could magnify the effectiveness of U.S. forces.
- (4) Soviet naval vessels have little capacity for mutual reinforcement in contrast to the well-developed ship-to-ship data links of the U.S. Enhancement of this capability by the U.S. can inhibit a dispersal Soviet navy from being able to be effective in meeting its first strike requirement of substantially disabling high value U.S. capital ships.
- (5) There may be a substantial payoff in reducing costs and increasing short war capabilities by going to the construction of a single "envelope hull" for various types of vessels while containerizing many of the specific functions. An "envelope hull" may be feasible for a limited attack carrier to supplement (but not replace) CVA/CVN, helicopter assault ship, underway replenishment ships, and a destroyer/submarine tender. The concept may also be applicable to SL-7 type hulls currently being employed for commercial purposes.

II. NONSTANDARD WAR AT SEA

Introduction

This series of papers is designed to stimulate thinking on unconventional - "nonstandard" - types of naval conflict. In many ways it is arguable that the "standard" naval wars are in fact not the most likely, and that less conventional types deserve far more attention than they have previously received. In this paper we will be concerned with conflicts between Soviet and American forces, although it is plausible that in future there will be many more conflicts involving only the proxies of the two superpowers. Such conflicts deserve further investigation.

The sea is a particularly interesting arena for great power confrontations. It is the most useful and natural highway between the continents, and hence the most useful medium for force projection. At the same time, however, a naval engagement need not spill over into a land war, and hence one initiating a naval war may imagine that he may avoid escalation pressure. The highway aspect of the sea makes its control a vital interest of the United States and of the Western Alliance it heads. This same aspect makes some measure of sea control vital for the Soviets, if they are to expand their power beyond the Eurasian land mass.

Since 1945 the Soviet navy has passed through two distinct stages. At first the Red Fleet was designed primarily to interdict Western naval forces in Soviet coastal areas; there seems to have been no hope of using the sea for its own traffic in wartime. Another function of the Soviet fleet would have been the classical attack on Western sea communications. Hence the construction of a very large submarine fleet, and of

cruisers and destroyers intended to disrupt Western force-projection units assaulting Soviet-held coasts. Later this function was extended to the defense of the Soviet Union against Western naval strategic forces, at first the carriers and later the missile submarines. It was this extension which seems to have inspired the construction of the surface-to-surface missile units which at present form a large part of the Soviet surface fleet. Much more recently this essentially passive and defensive orientation seems to have been replaced by a more activist one, looking toward Soviet sea control for their own force projection.

Force projection is essentially a wartime function, but the ability to project force despite opposition has strong political effects in peacetime. For example, the United States was able to operate virtually unopposed in Korea, Lebanon, and Vietnam largely because the Soviets realized that they had no credible interdiction capability. This semi-war experience almost certainly suggests to many neutrals that in a crisis United States units will be able to reach their shores while Soviet units will be forced off the seas. Unless the Soviets can reverse this perception, they will be unable to benefit in peacetime from whatever force projection capacity they have built up. Hence it is very much in their interests to destroy what they perceive as a myth of United States command of the seas. Similarly, it is very much in our own interests to discredit the very expensive fleet the Soviets have built since 1945.

A reading of Admiral Gorshkov's recent papers suggests that he believes very strongly in the classical (Mahan) interpretation of seapower outlined above: the purpose of a navy is the command of the seas, which is essentially a positive function. A worthwhile navy should be able simultaneously to deny the sea lanes to an enemy and to shield its own logistical forces using those sea routes. The latter implies a force projection capability such as the United States Navy demonstrated in World War Two. Physical evidence of Soviet interest in force projection includes their construction of three new aircraft carriers, which would seem to be intended to permit fleet operations outside the range of the large land-based Soviet naval air force. In addition, the cruising range of their larger missile units has been increasing, although, as we shall see, that is an ambiguous indicator. A more interesting indicator is recent Soviet long range cruises, which had previously been shunned.

The problem of the Soviet navy is that it has never proven its efficacy in battle. There is no glorious World War Two history comparable to that of the Red Army. A navy which began the war with the largest submarine fleet in the world did little damage to the Germans. It is true that the light craft of the Black Sea Fleet, which Gorshkov commanded, provided effective assistance to the Red Army in that area, but a serious historian of the war cannot escape the total inactivity of the heavier and more expensive units of that Fleet. In general one might say that the Navy had been a useful if inessential adjunct to the Army; but it is now the successor to just that Navy which wants more and more expensive warships, i.e., which wants to cut into the Army's budget for materiel and weapons. Nor is there much comfort to be gained from an examination of Czarist naval history. A large fleet built rapidly before World

War One failed to achieve decisive results either in the Baltic or in the Black Sea, although it faced little opposition in the latter theatre. And over any successes in 1914-17 must loom the great fact of the Russo-Japanese War. There must always be in the back of Soviet naval minds a fear that in some future crisis their formidable-looking fleet will find itself on the wrong side of a future Tsushima. Any failure to stand and fight the U.S. Fleet can only intensify this psychological problem; hence we can expect that in a future confrontation the Soviet Navy will almost be forced to accept action. Among the consequences of a severe naval defeat might well be a catastrophic collapse of their naval morale, and perhaps even a switch in policy away from naval expansionism. One might usefully consider an analogy with German naval policy in two world wars.

The German Navy of 1914 was built in part as a deterrent, for the Germans read Mahan to imply that a serious defeat of the Royal Navy would almost fatally wound Britain, whereas the loss of their own fleet would have little effect upon their fortunes as a land power. Hence they could afford to exchange their own fleet for a large fraction of Britain's in a war. Presumably the threat of such a trade would keep Britain out of a European land war. Unfortunately for the Germans they were unable to imagine circumstances in which the British, allied with their traditional maritime enemy France, would be quite willing to lose a major part of their own fleet in exchange for the defeat of a new naval rival.* In some ways more

* The Germans also did not expect that, in the decade before 1914, the French would decline so badly that the British would still be able to match them even after a serious battle. The other naval powers, the U.S. and Japan, could be discounted, the latter especially in view of the Anglo-Japanese Treaty.

unfortunately, this rationale was not the only reason for the existence of their fleet. The Kaiser saw the German Navy as an element of his national prestige, i.e., as an object of intrinsic value. To destroy this object--especially to destroy it as part of the planned strategy--was abhorrent. Hence the Germans' unwillingness to seek a general fleet action. When one did in fact occur, largely by accident, at Jutland, the German commander regarded extrication of his expensive ships as a matter of the highest priority. Although he actually achieved a favorable exchange rate--which was what the attrition strategy required--the implication felt in Berlin was not that attrition was practical but rather that the Imperial Fleet should not be risked in future. Men were released to the submarines and to the army, and the conventional fleet policy was cancelled.

The new fleet built after 1933 was designed for commerce raiding.* Once more it was seen as an expensive luxury, and quite possibly resources were committed to the Navy only because a navy was seen as a necessary trapping of a great power. The psychological flaw of German naval leadership became evident in the employment of the German surface ships; the key consideration became a desire to avoid losses.

Now, once more we see a great power building a navy which is, at least at first glance, a luxury. Certainly that might be said of its force-projection component. It is also an expensive luxury, and it is being built by a nation which has not done too well at sea in the past.

For the United States, on the other hand, sea power is anything but a luxury. If we accept that the Western Alliance is essential to our own

*There was also some element of sea control desired for the Baltic and for the nearby part of the North Sea; but this was practical only in view of the weakness of the opposing navies.

survival, then we must be able to control the sea lanes which bind it together. A very serious naval defeat could gravely weaken the Western Alliance, not to mention the effect of the enormously enhanced prestige which must adhere to a Soviet fleet which had shown itself a sure shield against the Americans. It must have been extremely disheartening for the Soviets and for their protectorates to observe the ease and indeed the disdain with which American aircraft carriers operated off Vietnam.

Hence the Soviets may have a large incentive to continue a purely naval war even if it begins accidentally. If they succeed in inflicting serious and visible damage during a first strike, they will also have a great incentive to break off the action at that point, so that neutral observers will be presented with a Soviet victory. In such a circumstance it is terribly important that at the very least we are able to disable their own fleet before the war terminates. Of course, the ideal would be for our ships to be able to fend off a Soviet first strike, then destroy the Soviet fleet almost as a reflex.

All of these factors lead us to the consideration of a short but high-intensity war at sea. The war is fought largely because of the prestige which attaches to the apparent winner: prestige among neutrals to whom forces may be projected, prestige or self-image at home and in the enemy's government. The war terminates, not because one side is wiped out--traditional naval wars have often been quite lengthy--but because

of fear of escalation.* Hence the important factor is the appearance of victory.

We comment parenthetically that the discussion below will also include a war fought to pressure the United States into expending its naval resources on tactical ASW, which is very expensive, so as to allow the Soviets to apply pressure successfully in some other theater. Such a war, a low-intensity submarine campaign, would appear at first quite different from the type already mentioned. However, the mechanism by which American participation is guaranteed is U.S. fear of losing the appearance of sea control.

Finally, a war of appearances is largely a surface war. The neutrals see things like the rate of sinking surface units, either merchant or naval. They cannot see what happens to the submarines, hence it is hard to impress them with the rate of loss of enemy undersea units. For the Soviets this means that a successful or semi-successful submarine campaign is measured more by the rate of sinkings they achieve than by the exchange rate. The exchange rate counts only as the war is extended, i.e., as the rate of loss of submarines begins to match or exceed the rate of commissionings. For reasons cited above, it seems quite unlikely that an intense naval war would last long enough for such a factor to become apparent to neutral observers. On the other hand, submarines are poor vehicles for force projection, so that the Soviets would prefer some kind of surface-fleet victory to one which showed only the survivability of their submarines.

* That is, because in fact there exist strategic weapons to which the naval war might possibly couple. A question of great consequence is the strength of the possible coupling between naval use of nuclear weapons and the strategic arsenals. By a political maneuver--by artificially strengthening those bonds--we can try to dissuade the Soviets from using their fleet optimally.

In fact a great strength of the U.S. fleet structure in a limited naval war is its potentially great volume of air-delivered conventional ordnance.

We have indicated above some of the factors which seem to impel the Soviets to accept naval war. However, it seems to us unlikely that they would deliberately initiate a surface war by surprise. Their present position is not an entirely undesirable one; they may be loath to test the quality of their fleet, in view of its past history. On the other hand, they may be quite willing to start a submarine war, which by its nature can be covert. In that case failure may be more difficult for neutrals--perhaps even for us--to detect.

The Soviet Fleet In Limited Naval Warfare

The Soviet fleet--indeed, much of the Soviet military establishment--is optimized for a very short, sharp war. The ships are designed for a high rate of fire, but this rate cannot be sustained for very long. For example, the big missile ships built since 1962 have no reloads for their surface-to-surface weapons. Indeed, considerations of deck space preclude any underway replenishment of the missiles. Hence, these ships have no alternative but to fire one massive preemptive salvo in the hope of killing their targets before any kind of reaction can be mounted.* One might reasonably deduce that such ships are intended to use nuclear weapons so as to ensure the prompt effectiveness of their first and only strike.

The crews are unlikely to be able to interchange conventional and nuclear warheads on the missiles in their tubes, which means that except in all-out (tactical or strategic nuclear) war the ships generally cannot use a part of their main battery. On the other hand, Soviet doctrine favors escalation to tactical nuclear war, so that Soviet ships probably will not be sent out with no nuclear weapons aboard. Hence it is possible by political means in effect partly to disarm Soviet ships.**

Its first strike mentality suggests the vital importance to the Red Navy of sophisticated and centralized command and control. The centralized

* And also in the hope of saturating terminal defense.

** A Soviet missile unit which has fired off its HE missiles and which cannot yet fire its nuclear ones is in a particularly uncomfortable position. If its intended victim survives the all-out HE strike, the Soviet ship has no further offensive capability, yet still must pay the fire-hazard penalty implied by its big (as yet unused) weapons.

system is necessary if all units are to be able to strike with some reasonable approximation of simultaneity. Otherwise, the intended targets may receive warning in the form of a partial attack; saturation may fail. A very centralized system would also seem most appropriate to Soviet society. The adoption of very long-range naval missiles with satellite targeting would be a kind of ultimate expression of this kind of impulse.

In a sense the naval missiles also represent an admission that the Soviets do not expect to be operating their own ships over very wide areas; a homing missile is most useful when all the objects it can see are potential targets. This is even more so with an ocean surveillance satellite of drastically limited data capacity; it is enough to say an object is a 'big ship' or even a warship, but to decide whether it is U.S. or foreign is very difficult. Any kind of IFF from the surface ships makes it easier for an enemy to use his own missiles.

At any rate the system of missiles and centralized C³ is very inappropriate to localized, limited war. The ships on the sea are by no means all enemies--and errors, such as the sinking of neutrals, are far more embarrassing than they are in full-scale war. More fundamentally, a limited war demands the local initiative and responsibility which the command structure is designed to avoid.

These considerations are characteristic of a system designed only for the big strategic war. Then the important targets are few in number and relatively hard to kill (attack carriers). Coordinated strikes are the only ones likely to succeed. Thus, one might speculate that one of the early motivations for the adoption of long-range submarine cruise missiles, which are targeted by the big Soviet maritime reconnaissance aircraft, was

a desire to centralize the targeting function of naturally independent units as submarines.

The first strike view is coupled with an absence of effective defensive armament. Soviet ships appear to bristle with such weapons as SAMs and short-range guns, but their relatively small hulls cannot provide much in the way of magazine volume, so that there can be little hope of surviving sustained attack. It may be that the Soviet designers are concerned with the survival of the ship only so long as its own attack is in progress. They tacitly assume that the Soviet fleet will always be able to strike first--which assumption is more appropriate to general war than to any (far more probable) limited war. This kind of reasoning, of course, need not motivate Soviet political planners, who have higher goals in mind than naval success. The same might be said of the tactical nuclear weapons policy. It should be a prime objective of U.S. political and military tactics to deprive Soviet forces of their opportunity to fight the kind of battle for which they seem to have been planned.

Another aspect of the one-strike fleet is the very limited (passive) survivability of its ships. Large masses of rocket and jet propellant are stowed above decks in the open, where they constitute a serious fire and explosion hazard.* In order to optimize the initial rate of fire, the designers concentrate weapons on deck, and do not try to locate their magazines below the waterline, which means that all ammunition is vulnerable

* It is only fair to observe that burning missiles are also much easier to jettison from above-water tubes. In many U.S. missile units magazine armor was premised not on enemy attack so much as on resistance to internal pressures in the event of a missile explosion. Here a factor was the mass of explosive material represented by the great number of reloads--often as many as fifty weapons per launcher. It was entirely impractical to carry the weight represented by these weapons very high in the ships. These large numbers were a consequence of the U.S. missile ships' mission, which was air defense during an extended campaign. By contrast, the Soviets have often claimed that they will try to achieve "victory by the first salvo."

to explosion by even superficial hits. The same maximum fire per ton policy results in very small hulls--and a small ship is generally easier to sink than a larger one, in terms of, for example, the number of underwater hits required. Once more, there may be at work a policy of writing off ships once they have fired.* That would seem a very costly policy in an extended low-intensity war in which no massive salvos were exchanged.

There is another way to look at this data. Westerners are always struck by the grim appearance of Soviet warships, although detailed analyses often show that as all-around naval combatants they are unrealistically armed and designed. It may be that the Soviets themselves demand maximum firepower per ton without thinking through the costs they are incurring. This is a common phenomenon in relatively inexperienced navies. For example, U.S. warships of the early phases of the modern navy (circa 1895) often seemed to foreigners to combine extraordinary armament with relatively low displacement. As the navy became more experienced, more subtle measures of ship efficiency were adopted. In the battleship case, it was realized that such "invisible" qualities as fire control and magazine capacity were more important than the number of gun tubes. A similar phenomenon occurred in Britain in the 'nineties: it seemed that commercial builders could always cram more guns into a smaller and cheaper hull than could the Navy's designers. The official reply was that the navies which bought the commercial designs were buying more front than substance. Here 'front' generally meant the number of guns and the trial speed; but often

* Such a policy may be symptomatic of an obsession with nuclear warfare, in which any hit is fatal, no matter how rugged the target unit. A navy expecting such assault can invest heavily in active defense or it can assume that at least some attackers will always leak through and try to cut its losses by building individually cheap units. Such a fleet will, of course, be embarrassed by non-nuclear warfare.

the guns were entirely unprotected, the magazine capacity was trivial, the trial was run under grossly unrealistic conditions--and the ship had hardly the coal capacity to leave port and return. Substance was expensive and unglamorous, but it was very useful when the navy had to fight.

The same may be true of the Red fleet. Ships are very expensive, and the Soviets are not too rich. They may well feel that light warships armed with heavy missiles are a shortcut to the type of seapower presently employed by the United States. The nature of their procurement process may preclude the production of large and apparently weakly armed warships such as those fielded by the United States.

Some confirmation for this view might be found in the multi-purpose armament of Soviet warships. They seem to be designed to operate singly, controlled centrally. They are most clearly not designed to reinforce each other in U.S. Task Force style, which means that the ships cannot be optimized in role as ours are.* Of course, their general unsuitability for underway replenishment may make it difficult for the Soviet escorts to accompany their larger units on extended missions. It is true that in recent years their ships have fuelled at sea, but the rate at which oil is transferred is entirely too low for use in a hostile environment. Once more, either the war is decided instantly, or it goes against the Soviets.

There remains the vast number of Soviet submarines. These cannot fire more than a few cruise missiles--in fact are unlikely to carry--but they have the traditional submarine virtues of relative invulnerability. Hence,

*Primary evidence is generally taken to be the absence of an effective ship-to-ship data link such as our NTDS and the predominance of ship-to-shore over ship-to-ship communications gear. There is also considerable operational evidence.

they can be used in a long- or low-intensity war; the penalty of failure to hit is not destruction. On the other hand, it may well be that within the next few years the act of firing a cruise missile will effectively localize the firing submarine, to the point of inviting retaliation. At the least the penalty for a mass missile attack on an incorrectly identified target is very serious.*

In such a world, many submarines are reduced to torpedo tactics. Even they may have trouble hitting fast units--and even many merchant ships are now quite fast.**

On the other hand, the submarines present their designers with few of the long/short war choices which affect surface ships. The submarines have no potential for visible armament, hence their design is unlikely to be compromised in that direction. On the other hand, submarines do have "invisible" characteristics such as low noise levels, efficient sonar, etc. Such things are likely to be most significant in a long war in which active

* Indeed, even an attack by a single submarine on a worthwhile target may be inadvisable, since terminal defenses may be quite capable of coping with one salvo. The submarine, like its surface brethren, carries few or no reloads. This means that any submarine commander has constantly in his mind a fear of decoying. Any announcement by us that we favor decoy tactics--even any decision to operate our naval units so that they sound mercantile--will greatly increase the reluctance of the submarine commander.

The submarine commander may, within a few years, have the added worry that the act of launching a missile will be instantly observable by sea surveillance satellites and may very quickly be transplanted into a missile strike on him. A system of this type would also be effective against SSBNs employed in a tactical-nuclear role, in which case the submarines might not be using full salvos. In its most advanced form it might consist of dedicated ICBMs with very fast retargeting capability linked to a network of low flying satellites with UV sensors. The warheads could be nuclear; but even MRVs with ASW torpedoes might work. The MRVing would be used to account for possible post-launch evasion by the submarine.

** Hence sound like carriers. The SL7 class container ships are the most prominent example.

ASW forces have been established. If the submarines are prepositioned for that massive first strike, it is not too important that they are noisy, since there will be no ASW assault prior to the attack. It will be far more important to emphasize numbers--both of boats and of torpedo tubes (i.e., torpedoes/salvo) per boat.

On the other hand, quieting is important in that our own passive devices may allow us to perceive the dispositions of Soviet submarines. Hence it may even be possible for us to identify certain operational patterns as "pre-war" and so to achieve a high degree of war warning. A particularly interesting case is presented by the noisy Soviet SSBNs, which are quite fast but which (in the case of the older boats) have relatively short-range weapons. They are not generally maintained on station off the coast, hence would have to transit the Atlantic--probably at high speed--to set up for an attack. This, too, is a measure of war warning.

We can use the existence of "war signals" of this type to trigger our own mobilization as late as possible, so that our forces are not depleted on M-Day. Or we can use our open knowledge of such "signals" to force the Soviets to forego optimum M-Day dispositions so as not to give their intentions away.

It is perhaps worthwhile to point out here the intimate connection between some effective form of sea surveillance and prolonged submarine war against shipping. A diesel attack submarine cannot maintain high submerged speed for long without snorkeling--i.e., without exposing itself to airborne radar. Hence, it is important for such a boat to be able to preposition itself with respect to targets, e.g., convoys. That in turn requires good intelligence. In World War Two, the German submarine fleet obtained its data mostly via cryptanalysis; but a Soviet

submarine fleet could never count on such a source. Ideally, it must have some kind of central intelligence clearing house, connected to air and satellite data.

This central command post, however, presents a vulnerability in the system. The submarine force commander requires timely notice of the status of his boats, if he is to plan attacks effectively. Hence, they must constantly announce their positions to radio directions finders.* Indeed, very similar circumstances prevailed in the Second World War, when the Germans had just such centralized control over the U-boat war. Short-range radio direction finding was used extensively as a submarine locator; and longer range systems were used to detect concentrations of U-boats.

Their very centralized command and control system can be used against the Soviets in several ways:

- i) Ship location by ELINT, both on the extensive outward-bound signal traffic and on the necessary ship status reports. The latter are necessary because the firing order cannot be given unless all units are ready to shoot. Otherwise all the C³ is wasted.
- ii) A very centralized system tends to destroy individual ship commander initiative, especially in the very ambiguous circumstances to be expected in a limited naval war. Hence, successful jamming of Soviet naval communications, even for a very short period, might be most useful to us. But--we must be willing to rely heavily upon the independent judgment of our own commanders.
- iii) Similarly, reliance upon satellite reconnaissance suggests the tactical value of an effective fleet anti-satellite weapon. This need not be too difficult to build, since the Soviet naval satellites operate at fairly low altitude.

* Burst transmissions and satellites make matters somewhat simpler, but on the other hand our electronics should be able to defeat bursts by very fast switching, and we can place ESM satellites in proximity to Soviet COM-SATs. They can do the same to us--which should make us leery of reliance on COMSATS.

The requirement for such a weapon might be combined with that for a counter to Soviet naval tactical ballistic missiles (SSN-13).

Particularly in a limited war, the sudden loss of fleet control might be a devastating psychological blow from which the Soviets would not have time to recover.

- iv) Of course, over-reliance upon electronics gives us the opportunity to insert our own false information into the system. In particular, it might be interesting to consider designing some of our ships to mimic some Soviet warships in external appearance, and, on a larger scale to consider decoying their satellites and aircraft. Or we might be able to insert spurious messages into their command and control system.

Under somewhat similar circumstances, the Pakistani 'answer' to Indian SSNs has been to fit out their fishing boats with corner reflectors and to keep them at sea in wartime; every trawler will seem (on radar) to be a destroyer. This is a response to the experience of 1971, in which the fishing boats were called home and the fleet was badly hurt.

In general, it would seem to the writer that we should look upon the Soviet command and control system, not as a wonder of the world to marvel at and imitate, but as a lever to destroy the Red Navy, psychologically and operationally.

An important attribute of the Soviet fleet in the dispersion of its firepower among numerous relatively cheap units. Some writers would go so far as to consider this dispersal a deliberate policy of survival via numbers and not via any kind of unit quality; they point to the absence of Soviet nuclear surface ships as a deliberate move away from expensive single units. A counterargument would be that the Soviets are probably limited by reactor production capacity; that it is more vital for submarines to receive what naval reactors are produced--as in our own Navy. One might even argue that ships of Soviet type would actually be better off conventionally powered. That is, in our fleet the weight which might otherwise go to fuel plus machinery goes instead into a heavier kind of

machinery. This makes sense only because of the very heavy fuel load we carry--the Soviets put more of the smaller displacements of their ships into weapons, for their first strike. Hence, the lack of expensive propulsion need not imply expendability. Indeed, historically "luxury" fleets have often been unable to accept major-unit casualties. The governments which have invested so heavily in what they secretly think of as international status symbols see very little point in losing them for gains they cannot grasp. Sea powers, by contrast, generally accept their ships as means, not ends in themselves, and hence open to loss. Thus German capital ship commanders in World War Two were often given as primary instruction that they should avoid contact with superior enemy forces, i.e., that they should not chance loss no matter what the possible gain.

What dispersal does mean is that the Soviet fleet's loss of firepower in the face of casualties is roughly proportional to the number of major (destroyer and above) surface units lost. If the ships are physically spread out, it is very difficult for a small number of attackers--e.g., a carrier air group--to kill most of them in the limited time span of the kind of war we are considering. In fact the Soviets add to the carrier's problems by installing some air defense weapons. Even if these are not very effective, they attrite the air group when the same aircraft have to attack many combatants. Similar arguments are often made for lightweight SAM's in ground combat. Stand-off weapons such as HARPOON may improve matters.

Now, any military force has to achieve some type of concentration in order to be effective. By using long-range cruise missiles and centralized command and control the Soviets can, in theory, achieve a concentrated attack on their targets using widely dispersed forces.

Physically, this is possible because the missiles require relatively little of their platforms--mostly good seakeeping and rudimentary survivability. The concentrated element of the system is its command and control.

We have chosen instead to use long-range naval aircraft. Their characteristics make it very difficult to build small platforms which are even marginally efficient--although the advent of good VTOL may change that. On the other hand, we ought to be able to maintain our strike power in the face of far more severe EW. That such may not be the case at present is an artifact of our operating habits, not of the basic situation.

The choice of aircraft as our basic weapon pervades our ship designs. Our destroyers are intended in large part as sensor platforms, their main batteries the carrier aircraft.* Although such a choice raises their unit cost, it also frees us of the absolute need for an external centralized control system: the carrier group is more or less self-contained. For the Soviets to turn to a fleet-based control system would be for them to increase enormously their vulnerability, since it would present to our weapons their concentration. Of course, we have already accepted just that risk by moving to carriers.

Recently, we have begun to disperse more firepower about the fleet via heavy ship-to-ship weapons such as HARPOON; but hopefully that is insurance against the loss or absence of aircraft rather than a significant shift. One might add that any concentration policy on the Soviets' part

* They are also primary AAW/ASW screens for the big carriers. In fact, the primary initial impulse for the production of the U.S. fleet AAW missiles was fear of attack in bad (i.e. carrier-unflyable) weather by landbased bombers with stand-off missiles. In addition the escorts reduce the strain on the carrier air group by providing some very short reaction time defense--the carrier need not maintain a constant very heavy CAP and anti-submarine air screen. However, it is possible that VTOLs of advanced design (e.g., FV12, if it works) can do the same job, i.e., that the current surface escort force might plausibly be reduced at some remote future date by a group of VSTOL ships, perhaps with large sonars.

increases significantly the value of a single incapacitating air strike. This may be why their "carriers" have such heavy armament--it may be assumed that they will be unescorted.

Our ships tend to be far larger than the Soviets', for the same kind of armament. Part of this is a concept of the fleet maintained at sea for very long periods: fuel endurance, economy at cruising speed, ease of on-board heavy maintenance, crew comfort. Part of it is a much heavier electronics complement, including such exotics as the naval computers and aircraft-direction equipment. Some size must also be ascribed to an allowance for growth.* This is the kind of consideration a navy learns only slowly and painfully; it would not seem particularly relevant to a fleet growing rapidly and practically bursting to achieve the greatest and most visible firepower per ton of displacement.

A situation just short of war requires dispositions which may be very different from those realistic in wartime. For example, the Soviets in the Mediterranean steam in formation and use a flagship. They must, for visual effect on noncombatants. Yet the reasoning above suggests that this is just the opposite of an effective war disposition. On the other hand, a greater degree of concentration is in any case endemic to U.S. naval architectural doctrine.

Now, the kind of war we are considering often grows very naturally out of peacetime dispositions. Hence, we can hope to take advantage of the contradiction between Soviet ship design and Soviet operational practice.

* By way of contrast, the Soviets seem to find it very difficult to refit their (presumably more tightly-designed) ships. The U.S. DD963 class is probably the most extreme case of a ship designed with future refits in mind.

The U.S. Fleet^{*}

As we have already indicated, the U.S. fleet is built around carrier-based naval aviation. Most of our surface ships are intended either as carrier escorts or as counters to an expected Soviet submarine offensive. In either case, the most important attributes are long endurance, good sensors and communications, and effective AAW and ASW weapons. Enemy surface ships are to be countered mainly by our own aircraft. This set of priorities mirrors the naval realities of the immediate postwar world: a large Soviet underwater fleet supported by ground-based naval aircraft. In a sense it is still appropriate to the current Soviet fleet, since current Soviet cruise missiles are in effect small pilotless aircraft.

In a design sense we must emphasize long range and magazine capacity for sustained or repeated attacks. Endurance means more than just un-refueled radius of action; it means habitability and provision for rapid replenishment at sea. It should also mean an emphasis on survivability: There is every possibility that our ships will be attacked far from base, and it is important that they be able to survive a long voyage home. It is not clear that we have sufficiently emphasized this side of ship design.

All of these requirements make our ships far larger than Soviet ships similarly armed. Large magazines must fit inside hulls, not atop them; and survivability demands that they be below the waterline for protection against bombs and missiles. Sensor requirements couple with the need to maintain stability to force up the size of the hull, and often we must accept less than optimum seakeeping qualities in order to achieve the kind of endurance we want.

^{*} See also Chapter III, "The U.S. Fleet in Limited War."

To some extent the qualities already inherent in the U.S. fleet are just those which are best suited to a limited naval war. But that is not always the case. In particular,

(i) We must improve survivability. In a short war ships on order are irrelevant to the outcome, and indeed ships out of action for as much as three weeks may be as good as sunk. For our larger ships--including big merchantmen--there may be insufficient drydock facilities to cover even a moderate run of torpedo attacks. Hence there is a real need for design to minimize the extent of damage, and for some means of repair without docking. The latter might be paid for out of the routine (present) needs of supertanker operators. Yet another wartime target would be the normal merchant ship. There should be some measures we can take to improve their chances in the first weeks of a submarine war.

The nonstandard point here is that in classical underwater campaigns it has taken the defense quite some time to achieve any kind of edge. If the war artificially terminates much earlier, we must at least seem to be making headway. This consideration extends to the provision of active ASW and ASMD aboard the merchant ships.

(ii) To some extent we must spread out our anti-ship capability. This is already happening in a limited way; the object is to reduce the tactical advantage of disabling a carrier.

This is a question apart from any wish we may have to disperse without losing our own concentration. That is a matter of range of tactical weapon and command-and-control, and one might see it primarily as a counter to nuclear attack.

Dispersal of force, on the other hand, merely cuts the value of any single hit. In the Soviet's case, any very considerable multiplication of the platforms they must target can place a serious strain on their targeting/C³ organization, as well as forcing upon them a great escalation in the number of their own platforms. In a conventional scenario, there is, moreover, no great point in geographical dispersion of the high value units; rather, it might pay to concentrate so as (i) to confuse incoming weapons and (ii) to make practical linked operation of AAW weapons and sensors, e.g. via NTDS.*

The difficulty in such a policy is the very great cost of the U.S. high value units. Some possible ways out include

- (a) Production of significantly less expensive units, e.g. VTOL carriers, to supplement but not replace the current ones.
- (b) Decoying
- (c) Some device which converts currently secondary units to high-value status. For example, if in fact HARPOON can kill a Soviet missile cruiser with one hit (it cannot), then the Soviets may perhaps feel that they have to take any HARPOON-capable unit seriously. Similarly, if VTOL works well, then the LPHs, LHAs, and even the LPDs become serious strike platforms--albeit far easier to sink than is a CVN.

Increased lethality need not involve very exotic developments. A good candidate, given modern avionics, is a missile designed to explode under the keel of a target ship. Such a weapon defeats the target by flexing the entire hull of the ship; there is literally no passive defense. Yet relatively little explosive is required.

* For example, it might be possible to operate two or more separate radars (or sonars) coherently, using very short range (e.g., laser) communications links. Coherence might be practical if the relative range and bearing of the cooperating units could be measured continuously and accurately. Lasers might be useful in this role.

It is not at all that our ships will not survive to strike twice, but rather that the Soviets are unlikely to remain concentrated for very long, once they know that it is war. Their ships concentrate in peacetime for effect, but they are intrinsically unsuited for combat cooperation. Hence they ought to scatter rapidly once war begins. One suspects that they would not scatter even in a very tense situation for fear of losing face.

An interesting possibility suggested by these points may be mining operations in areas Soviet ships must pass on their way home; the object being to magnify weapon lethality by causing damage en route to repair facilities.

Naval War Initiation Concepts:
Some Scenarios

We can imagine wars begun either deliberately or accidentally, and carried on either overtly or covertly. In addition, we can distinguish between naval warfare carried out against submarines, against surface targets, or against naval aircraft; and, of course, most naval wars have been combinations of the three. In what follows, we are primarily interested in naval wars between the Soviet and American navies, perhaps with allies involved.

As we have suggested above, the Soviets may have a large incentive to continue a purely naval war even if it begins accidentally. If they succeed in inflicting serious and visible damage during a first strike, they will also have a great incentive to break off the action at that point, so that neutral observers will be presented with a Soviet victory. In such a circumstance, it is terribly important that at the very least we are able to disable their own fleet before the war terminates. Of

course the ideal would be for our ships to be able to fend off a Soviet first strike, then destroy the Soviet fleet almost as a reflex.

It is also necessary to recognize that there are circumstances under which American initiation of a naval war can be imagined. For example, a first strike on a large Soviet naval concentration might be a counter to some limited Soviet attack in Europe. If we had some reason to expect that our attack would be very successful, and would be confined both in space and in time, it could be presented to the Soviets and to the world as a deliberate and limited--even very restrained--use of force as a demonstration of resolve. Such a demonstration might be valuable in the context of an indecisive but limited NATO war in Central Europe. It would have the useful side effect of destroying a Soviet force which might in future be a threat to us; and for the reasons given above, it seems unlikely that the Soviets would rebuild their fleet very readily.

In all of these cases it is essential for us to recognize that the naval war may be carried out in the intimate presence of neutral shipping. Hence our ability to strike Soviet shipping may hinge on our ability to distinguish it from neutrals. This has not been the case in former wars, but it seems suggestive that in October, 1973, the Soviet Mediterranean squadron tried to disperse among the merchant ships for protection. We must be wary of building ships which can easily be picked out by those so disposed. Particularly in the Mediterranean and in the North Atlantic, a very sudden naval attack, especially one run under IFR conditions, may run afoul of this problem. Not only is it embarrassing to damage neutral merchant ships (or even one's own, in a very sudden outbreak), but the 'false' targets will tend to absorb the limited inventory of missiles.

Now we can pass to some scenarios. We can consider wars initiated deliberately and pursued overtly, i.e., the classic case; wars initiated deliberately but pursued covertly; wars initiated by accident and not terminated at once, to run either covertly or overtly; and combinations.

An example of the classic case is Soviet assistance to an ally being attacked by U.S. naval aircraft. We assume an escalatory situation, e.g., in Korea. The North Koreans once more mount a full scale invasion of the South, but now the only available U.S. aircraft are those of the Seventh Fleet. With many South Korean airfields out of action due to (say) sabotage, the U.S. government decides to provide tactical support via the two carriers of the Fleet. The Soviets protest at this U.S. "aggression," and begin to trail the carriers with missile units of their Pacific fleet. This is all fairly standard. A new element might be the transfer of a Chinese missile destroyer to North Korea, as an earnest of Chinese willingness to do more than talk. The missile destroyer, crewed by Chinese, might attempt unsuccessfully to engage the U.S. units, and there would be the spectacle of a Communist warship trying to protect another Communist country sunk while the warships of a third Communist power looked on impotently. A kind of naval machismo would be involved, and quite possibly the Soviets would have to engage. They would not like to, but the decision would be taken quite deliberately, perhaps to recoup lost face. The ensuing naval war would be overt, and probably limited to the immediate area off Korea. The Soviets might find it judicious to use the hot line to assure the United

States that their units elsewhere would not be involved; their intention would be to avoid a U.S. first strike destroying the Soviet Mediterranean Fleet.*

An important aspect of such a war would be the warning time afforded U.S. units. There might well be enough time for us to put interceptors far enough out to intercept incoming cruise missiles. In addition, the limited character of the war would seem to preclude Soviet use of nuclear weapons, however tactical. This limitation could mean

- i) Inability to sink U.S. capital units
- ii) Delay due to the necessity to change weapons in home ports
- iii) Attack confined to a few submarine strikes. There is reason for skepticism as to their success against high-speed warships, as long as nuclear attack is excluded.

A classic kind of deliberate but covert war might be covert submarine warfare.** The motive for such a war might be a hope of diverting U.S. defense resources. The war begins with a spate of merchant ship sinkings, apparently by torpedo. No one takes credit for the sinkings, but it becomes clear that ships enter U.S. ports at their peril; only U.S.-bound ships are sunk. The purpose of this restriction is to dissuade our NATO allies from contributing ASW forces.

* Another Korean scenario is presented in the accompanying paper, "The U.S. Fleet In Limited War." In the kind of scenario given above, a great deal would depend upon how seriously the United States would have to treat loss of a carrier. That in turn might depend upon how rapidly carriers could be replaced; one choice might be to use the big carriers as tripwires, attacks on which would be taken as attacks on U.S. territory--that almost seems to be present policy.

** A precedent might be the Italian submarine campaign off Spain in 1936/37, which was called off when Britain and France instituted active ASW measures in the area.

A glance at Jane's Fighting Ships suggests that only the Soviet Union can field the number of submarines required for such an attack, but stiff protests to the Soviets yield only stiffer denials that the attacks are Soviet in origin.

The U.S. is forced to mobilize its ASW forces. It cannot afford to sink submarines on sight, since they may be innocent neutrals--and the Warsaw Pact countries supply such "innocent" neutrals in the form of their own submarines operating in the sinking zones. Hence, the American ASW effort must be in convoying and in ASW only after ships in convoy are sunk. This is a relatively expensive effort, and the great number of small craft involved quickly exhaust the Navy's limited manpower. Moreover, there is no way for the Navy rapidly to build capable escorts, in view of the limited shipbuilding and ordnance-building capacity of this country.

In an alternative formulation, any one of a dozen nations in South Asia becomes dissatisfied with Japan and begins a campaign against tankers transiting the Malacca Strait. A problem we then face is deciding whose submarines to sink--and we may find it difficult to attack the owners of the submarines when the public feels that much less escalatory ASW measures will work well enough. Such operations can be made to raise serious Rules of Engagement questions; see Chapter III on "The U.S. Fleet In Limited War."

Admiral Gorshkov has emphasized the very great and disproportionate cost of ASW in World War Two: the Allies had to field more than 100 men for every 1 U-boat sailor. This does not begin to suggest the cost of ship construction and of weapons development. The imbalance would be even worse if the U.S. had to field a force comparable to the full Soviet strike force, yet the Soviets withheld most of their boats from action.

Further, it may be difficult to detect and sink submarines except when they approach convoys. This will be particularly the case when most submarines in an area are not hostile. A submarine captain interviewed has indicated that a submariner who wishes merely to survive his war patrol should find no difficulty in doing so--but he will sink few merchant ships. But if the idea is to sink only a very few ships....

The initiators of the war can cause further strains by periodically relaxing the sinkings until the convoy system is dropped, then building up again to obtain the maximum effect at minimum cost.

Of course, eventually some crew members of a submarine are recovered by the American forces. They are demonstrably Soviet, but the Soviets can always claim that they are clearly individuals working alone. Even if many Soviet sailors are captured, all that happened is that the Soviets decide to terminate; for any appropriate retaliation would have to be many levels higher on the escalation ladder.

A frequent assumption seems to be that naval war will begin, like any other kind of war, by accident. As we have observed, the Soviet fleet is not likely to survive an American air strike countering a partial (accidentally delivered) first missile strike, e.g., in the Mediterranean. Hence one suspects that, should a Soviet ship accidentally fire, the Soviet commander would be very tempted to put into immediate execution his first strike plan.

A likely setting for accidental war is the Mediterranean, where U.S. and Soviet ships cruise with their weapons trained on each other, virtually at war stations. An important trend in naval weaponry is towards

total automation, and perhaps we should be concerned over the possibility that some "glitch" in electronics could release a missile or a naval gun. Lest the reader think this a fantasy, he is reminded that at least once an American F100 making a dummy pass shot down a B52 with an accidentally released Sidewinder. Ships at sea are subject to far more severe environmental problems than was that fighter,* hence one ought to be far more suspicious than an accidental weapon release might occur. Just how serious any Soviet weapon release might be would depend in part on whether the Soviets normally load nuclear or conventional warheads.**

Finally there is the war started accidentally and then continued covertly when the profit inherent in the accident is perceived. For our example we consider the Mediterranean once more. We assume that a new Middle Eastern war is in progress. In the Arab buildup preceding the war, the Soviets transfer to the Egyptians modern escorts comparable to those in their own Med Fleet. Israel buys no U.S. ships, but does adopt as her main anti-shipping weapon an air launched missile such as Harpoon. Her reasoning is that the new Egyptian surface units present a direct threat to her cities, and that it is essential to find and sink them at once. The Israeli missile boats can operate only at night, and have a relatively low probability of finding an enemy. The justification for

* The accidental firing in that case was traced to corroded contacts in the missile launcher. More recently an automatically actuated shipborne anti-missile weapon (PHALANX) accidentally opened fire on an accompanying ship. The need for extremely quick reactions intensifies the problem of such weapons.

** If in fact the Soviets are set up for a massive preemption of what they see as a U.S. carrier-based strategic attack, then they almost have to have nuclear weapons aboard. It then becomes an interesting technical question whether they take seriously the problem of accidental release. On the other hand, a full appreciation of the possible need to fight a limited war at sea would seem to imply that some or all of the nuclear weapons are stowed at bases--and very likely NOT Soviet bases abroad. The dilemma is actually a consequence of the limited reload capacity already noted.

this picture is to be found in experience of the 1973 war. The new feature is that the Israelis have reason to assume aggressive behavior on the part of the new Egyptian units.

At the outbreak of war the Israeli air force searches at once for the Egyptian missile escorts. These ships are essentially indistinguishable from ships which make up the bulk of the Soviet fleet. Hence Soviet ships can avoid attack only by leaving the battle area, or by showing some kind of recognition signal, which the Soviets might find humiliating. Moreover, should the Israelis be deterred from attacking them by fear of drawing in direct Soviet participation in the war, the Soviet ships will have served to screen their Arab counterparts from attack. It is likely therefore that the Arabs demand that the Soviet fleet remain in the battle zone. But it is also likely that they attempt to use their own missile ships aggressively against the Israelis. Hence there is a reasonable chance that a Soviet ship is sunk by an Israeli missile.

At this point the Soviets can either pull out, as in the past, or they can try to behave like a classical sea power, i.e., tough it out. Such behavior would, as we have suggested, be extremely attractive at least at first. In this case it might consist of a large scale movement of Soviet land-based naval aircraft into Egyptian and Libyan airfields, the aircraft to provide CAP. At present most Soviet fighters are not suitable for such long-range operations, but that is likely to change.

But the Soviets are not alone in the Eastern Mediterranean; the Sixth Fleet is there, too, flying constant sorties to determine just what the Soviets are doing. Its aircraft are virtually identical to those flown by the Israelis, and surely those aircraft will be attacked. The Sixth Fleet will suffer attrition of its main battery.

There are only a limited number of pilots in the Sixth Fleet, and a limited stock of aircraft. If that stock is seriously depleted, the Fleet must leave the battle zone. At the least, the U.S. is forced to decide whether to take the major escalatory step of moving in another carrier. However, to withdraw the Fleet would be a major blow to Israeli morale, not to mention to our ability to resupply Israel.

The covert character of this naval war lies in the fact that the Soviets are nominally at peace with us; they are merely flying CAP over their own fleet, which is itself not even engaged in the Arab-Israeli war. Their justification for shooting on sight is that modern ASMs have ranges as great as 50 or 60 miles, hence the CAP cannot allow any suspicious aircraft near the ships. The Soviets deeply regret the loss of U.S. aircraft, but they do after all have an obligation to protect themselves. On the other hand, the U.S. has the need to obtain constant information as to the movements of the Soviet fleet, i.e., to fly aircraft right through the Soviet CAP.

The short character of such a war derives from the Soviet strategy, once they realize what a good thing they have. The air attacks quietly terminate as the Fleet withdraws to replenish. No statement on our part can dispel a pair of apparent realities:

- i) Our carriers can be beaten by shore-based air, without ever being attacked directly,
- ii) The Soviet Union is an effective shield against the U.S. Fleet

There are precedents. In 1964 a British writer in The Navy suggested that the North Vietnamese attacked a U.S. destroyer because there were U.S. World War II-built escorts in Vietnamese service; inexperienced

crews could not distinguish between ships of basically similar construction. All modern Soviet warships have a consistent style to them, and an inexperienced pilot--especially in conditions of poor visibility--cannot be expected to identify them properly. The Liberty attack of 1967 might also be cited to this point.

As for an assault on the air component, the reader is referred to the Marianas "Turkey Shoot" of 1944, in which the Japanese Fleet was defanged by the destruction of its aircraft--very little of its shipping was destroyed.

This list by no means exhausts the very large number of plausible scenarios. For example, one might imagine deliberate Soviet strikes on a U.S. operation in support of one of our client states against one of theirs, even in the absence of some provocation--although such a strike would seem to this writer less likely than the unwilling Soviet action already described. For example, the next Middle East war might see Israel unwilling to halt, and a belligerent U.S. supporting her unwillingness. In the face of disaster, the Arabs would demand direct Soviet assistance, and the cost of Soviet failure to engage would be the loss of all Arab support. It might turn out that it would be far easier for the Soviets to assault the Sixth Fleet than for them to strike directly at Israeli land forces. At least it might seem that way, if U.S. and Israeli forces were so intermingled that an attack on the latter were automatically an attack on the former.* Presumably the Soviets would try to make a single stunning attack, then withdraw and offer to negotiate. The intent would be to show the color of victory--especially if the land battle were very much the opposite. An interesting precedent

* i.e., if there were no way for the Soviets to avoid attacking some U.S. forces. The sea attack might be more useful tactically.

for this kind of attempt to save face at sea is the Battle of Lissa in 1866 between the Italian and Austrian navies. The Italians lost terribly, but as their ships sank the sailors were able to cry out, "Venezia is ours!" The Italian army had won the important victory, but the Austrian navy saved Austria's face.

Yet another class of scenarios might result from a U.S. strike on Soviet naval forces attacking a U.S. client state, for example in the Persian Gulf. As in an earlier case, the hot line might be used to limit the geographical scope of the ensuing conflict.

In every case the key considerations are:

- i) How the war seems to go.
- ii) How rapidly decisive-looking results can be attained, since the war has to terminate.
- iii) A consideration implicit in any intrinsically limited war may be the extremely high rate of material wastage, as neither side sees any point in economizing for a long pull.

The prototype of this kind of war would seem to be the War of October, 1973. Here is a war begun deliberately, it now appears, to draw in Soviet and oil-state financial backing, and to present to the world an image of Arab victory. The extremely limited scope of Arab--especially Egyptian--war plans suggests a perception that the war would soon terminate due to outside pressure. In fact that was the case, except that the pressure came rather more slowly than the Arabs might have liked. Even so, they have been able to present their war to the world--and to themselves--as a great victory. And certainly Egypt is better off two years later than she was in October, 1973.

III. THE U.S. FLEET IN LIMITED WAR

The U.S. fleet as it exists today is very largely the product of staff requirements and specifications dating from the late fifties and early sixties, themselves the secondary and tertiary effects of the lessons of World War Two and of the technology born in 1945-55.* This is no great defect, but it is a fact which must be well understood before we can make effective suggestions for new technology specially suited to the likely naval wars of the future. A careful look back can also help us to pick out those technological initiatives which failed when they were suggested, but which would have succeeded with current technology--and which should be revived. DASH, an ASW RPV, may be a prime example.**

The three great naval facts of 1945 were the nascent strategic power of the fast carrier task forces, the problem of ASW, and the success of amphibious warfare. Against these three could be set the unknown future of nuclear weapons and of pilotless missiles. The only really new system developed since then has been the ballistic missile submarine, in which a

* For example, the first specification for a U.S. nuclear submarine was written early in 1946, and incorporated wartime U.S. and German technology dating from (say) 1942. A detailed specification was written only as late as 1950, and the first nuclear boat went to sea in 1954. In fact this prototype still did not incorporate hydrodynamic advances of the war and immediate postwar periods; one might say that the first full expression of the underwater technology in embryo in 1945 was the teardrop-shaped Skipjack class commissioned from 1959 on. And this was a program pressed forward quite vigorously. In other cases, such as the AAW missiles, weapons were fielded well before they were fully developed, in view of the very serious perceived threat.

** DASH was a small unmanned helicopter fielded about 1960. It was extremely unpopular, some Captains reportedly flying their DASHs into the sea to get rid of them--yet it was relatively simple by current RPV standards.

perception of the futility of strategic ASW is married to a highly developed missile and a miniature TN-bomb.

After 1945 the Navy spent its resources on the assumption of three kinds of scenario: (i) strategic strike against the enemy heartland, using fast carriers and later submarines; (ii) a new Battle of the Atlantic; (iii) a new amphibious campaign. (iii) was taken to mean that the 10 knot amphibious force of 1945 should be upgraded to 20 knots, but was assigned the lowest priority in view of the fact that the existing rather large forces could still carry out a useful mission; the 20 knot amphibious lift has only very recently been realized. (ii) received a very heavy funding in view of radical submarine developments at the end of World War Two. However, ASW required such large numbers of units that of necessity emphasis had to be placed on refitting existing ships.* The one area absolutely requiring new construction was strategic strike. Airframe developments have made new and larger carriers necessary, and the evolving threat has demanded a new category of escorts. In fact these escorts now constitute a substantial part of the U.S. surface combatants.

In the immediate postwar period the primary threat to the strategic force was conceived of as airborne: bombers and torpedo aircraft for the immediate future, bombers with stand-off missiles within a few years.** So seriously was the latter threat taken that the Navy pressed the development of the TERRIER AA missile at high priority even when the Bureau of

* Which means that it is ASW which has suffered most heavily as older units are scrapped. One might somewhat change this evaluation were the SSNs to be considered ASW units.

** In particular, a long-range bomber with radar might approach in weather the carrier aircraft would find unflyable.

Ordnance indicated that each TERRIER launcher might fire only twice per hour (1948). For fair weather, effort was put into improved radars and a new 3"/70 automatic gun.

Because the missiles were big, because they required a lot of magazine capacity and a lot of (heavy) radar, the missile ships were big--and expensive. The conversion of two heavy cruisers, Boston and Canberra, was pressed, but for budgetary reasons only one of their three gun turrets could be replaced with missiles. The earliest missile studies envisaged cruiser construction or conversion, especially for the big long-range missiles such as TALOS. In the beginning the scenario envisaged was attack by solitary intruders under distinctly IFR conditions.

For daylight AAW the Navy could still rely on radar-controlled gunfire, which was far simpler, cheaper, and more reliable than the missiles.* Even without missiles, however, any fast carrier escort role demanded high sustained speed, which in turn meant respectable size.** Thus the first post-war destroyer, the Mitscher, was so large that it had to receive an entirely new rating, "frigate."

The Mitschers were designed in 1948. By the time the next class of gun-armed "fast task force escorts" was in the design stage, some of the AAW missiles had shrunk to the point of being suitable for them, and the era of "missile frigates" began. These could never be entirely satisfactory, and as time went on the missile frigate and missile cruiser categories merged. The process was only accelerated by the introduction of nuclear power; for example, the Long Beach began as a nuclear missile frigate design study.

*And the guns were only backing up the carriers' CAP.

**A great complaint against wartime destroyers had been their inability to keep up with the carriers.

The reader will note a certain absence of concern regarding the hundreds of Soviet submarines and the hordes of Soviet warships in existence even before 1960. The reasons were that a submarine armed with an unguided steam torpedo is perhaps the least opportune vehicle with which to attack a fast carrier; and as for the surface units, the carrier planes were expected to cancel them out--if indeed they ventured out far enough to sea to create a menace.* The function of the fast carriers was to project sea power, not to tangle with the Soviet fleet. Even the development of the early Soviet ship-to-ship missiles changed matters very little. A missile like SHADDOCK is, after all, no more than a small and unsophisticated airplane, and responds to the usual AAW measures.

Of course the application of nuclear power and later advanced missile technology to Soviet submarines did present a certain ASW threat, and in fact the Fast Task Force Escorts did receive some substantial ASW capability. But even then they remained primarily AAW escorts.**

By 1975 we see in the Navy very well developed carrier striking forces, a large ASW organization, and a 20 knot amphibious lift. The emergence of missiles for AAW has had the peculiar effect of eliminating those naval guns which in the past had been used to support the troops ashore without being credited to the amphibious warfare budget.*** A much more obvious gap was in forces for low-level anti-ship warfare. The new fleet of the

* I.e., out from under their own shore-based air cover.

** The Spruance class is the first move towards primarily ASW escorts for fast carriers.

*** A prototype fast fire support ship, the Carronade, was built in the fifties for the 15 knot amphibious force, but she was not repeated, partly in view of the mass of existing gun-armed ships. More recent proposals for special fire-support ships have failed on budgetary grounds.

fifties and sixties had been designed only to fight World War III, but in fact it had fought instead a series of low-intensity wars.

Fortunately those wars had exercised the flexibility inherent in the big carriers and in the mobile troop lift. The opposition had little anti-ship capability: there was little direct threat to the expensive carriers; and the very limited geographical extent of Vietnam and Korea did not point up the rather limited number of available carriers. Most fortunately of all, there had always been just enough of the old pre-missile navy left to fill in the gaps between the new scenarios.

In this light we can examine some of the major components of the U.S. Fleet as they apply to possible very limited kinds of naval war. We assume that such wars are of three basic kinds: (i) support of allies involved in limited land or amphibious warfare (e.g., Korea, Vietnam, Lebanon); (ii) conventional anti-fleet operations against the Soviets or lesser navies; (iii) ASW. Of course these three may be mixed. We can tacitly assume that any sea power projection against Soviet territory would be a quite extraordinary event probably involving nuclear weapons, although perhaps it can be envisaged in the opening stages of a NATO war.

The Carriers

In effect, by buying a relatively small number of very capable and very expensive carriers we are saying that there are only three relevant scenarios: (i) peace; (ii) Vietnam/Korea, in which the carriers operate with impunity for periods of years; (iii) the apocalyptic war in which

the carrier has to fly off only a few sorties, and in which there need be no consideration of a next week, let alone a next year. Carriers now take so long to build that there is no way that sinking or serious damage can rapidly be made up out of new construction, which in turn means that to lose even one carrier in any way that is not apocalyptic is a national disaster. If, in fact we are moving into an era of limited but nasty naval wars, and if these wars follow upon each other with unpleasant frequency, the approach above has very serious defects. We cannot continue to build a fleet which cannot keep fighting for a long time in the face of capital ship losses.

This is not even a particularly new situation. In the thirties the Royal Navy (and ours) was limited by treaty to eighteen and then to fifteen capital ships and forbidden to lay down others for many years. Battleships took a very long time to build; in particular their armor required elaborate plant and gun mounts were a great bottleneck. A long 'holiday' in such construction had led to the debilitation of both armor and heavy gun industries.* In 1935 the Italians invaded Ethiopia and the British had to consider intervention. A major deterrent was fear that although the Royal Navy could destroy the Italian fleet, it might lose its world position in the process. Capital ships were too valuable to use. This might be restated as, 'since we expect to have to fight the big (apocalyptic) war someday, we cannot be bothered to risk our precious forces for anything less.' It was not so much a conscious attitude as the outcome of a series of apparently unrelated technical and political choices.

* When the British finally did begin to build battleships, they had to buy the steel from Czechoslovakia and later Germany--which by then (1938) must have expected to fight Britain.

A proposal in what may be the right direction has been made by an Australian firm.^{*} They note the very great variety of roles to which a single basic carrier hull (British Colossus Class Light Fleet Carrier) has been put: attack carrier, ASW carrier assault (helicopter) ship, troopship, heavy repair ship. Surely one can deliberately build a single basic hull and containerize many of the systems specifically required for various functions. In the case of the U.S. Navy, the proposal might take the form of a common 'envelope' hull for: limited attack carrier,^{**} helicopter assault ship, at-sea replenishment unit, destroyer/submarine tender. Some of these ships are almost always under construction. The modular character of the design would mean that carrier losses could be made up out of construction originally earmarked for other purposes. The alternatives are not very attractive: a large reserve of expensive units with which to absorb losses; or a general cut in unit quality to keep excessive numbers active; or a fleet which dares not fight where it might face losses.

One can take this reasoning a step further. Modern merchant ships such as the Sea-land SL7 are coming closer and closer to aircraft carriers

^{*} See Navy International, April 1975, pp. 22-26. In the U.S. Navy there have been several commonality projects. Thus the Iwo Jima class LPH and the Blue Ridge class command ships share a common hull; there was a project for a 'universal' auxiliary hull based on a landing ship (dock); the DD963 was to have had a DDG half-sister. And of course there is the precedent of the auxiliaries based on Maritime Commission standard hulls.

^{**} 'Limited' because there is no great point in making everything equal to a Nimitz. But there is a valuable role for some numbers of less capable and easily reproduced carriers. Modern attack aircraft such as A4 and A7 do not need nearly the facilities of a CVN, hence one might imagine a carrier group in which the CVN provided fighter cover and the limited carriers provided the strike component.

in speed and in size, although not of course in internal subdivision. The Maritime Administration is embarking on a large construction program. Perhaps it is worthwhile for the government to subsidize some expensive features in a new generation of standard hulls to fit them for use as naval "envelope" hulls. If such a step is practical, it would increase the base of hulls from which prospective carrier losses could be made up.

A consequence of building many units with nearly identical hulls and power plants is that it becomes very difficult for submarines to be certain of identifying ships they hear as carriers or as large merchantmen. Submarine commanders will be reluctant to waste their few cruise missiles on "gray" targets. Hence they may find it absolutely necessary to communicate with the Soviet air forces, i.e., to expose themselves to ESM-supported attacks. Big container ships on carrier-like hulls may even look like carriers to radar search aircraft, especially if they are provided with a few VTOLS or helos for self- or convoy-defense.

Such a program might have as precedent the deliberate design of a series of pre-World War Two tankers for naval use and ultimately for conversion to small carriers (Sangamon class); some pre-war U.S. and Japanese liners were designed for similar conversion. A sort of reverse twist is the British Colossus class, designed as carriers convertible to ocean liners after the war.

There remain the missile-armed escorts. Their primary characteristics are that they can keep up with the fast carriers, and that they can carry large quantities of AAW and ASW missiles and sensors. Maneuverability no longer counts for very much, hence there is not much point in keeping down the size except in that unit size and cost go together. If we are building a lot of medium carriers, perhaps we should use the same hulls for their

escorts. This makes sense, of course, only if the 'limited' carriers are fairly small. A precedent (in the reverse sense) might be the light carriers (CVL) built on cruiser hulls by the Navy in 1942-46. These ships were large enough to operate light jet attack aircraft such as A4's; their cruiser counterparts were the missile cruiser/fleet escorts of the fifties.

If we take these ideas seriously, we must settle questions of passive protection and propulsion. At present by law major U.S. combatants must have nuclear power. But nuclear power is a major reason why a carrier like the Nimitz takes seven years to build.* It also restricts the number of available shipbuilders, i.e., there is no way to push up the rate of commissionings except at the enormous cost of starting up new shipyards. In any case there is very little point in providing hundreds of merchant ships with nuclear power--unless there is some way to build the nuclear plants themselves in modular form so as to permit interchangeability with more conventional plants. This seems unlikely, however, in view of the fact that reactors usually outweigh conventional plants plus their fuel.**

Protection is a more subtle question. In modern U.S. attack carriers a considerable fraction of the displacement is devoted to various forms of armor, including systems of bulkheads to control and limit damage from

* Five had been expected. In contrast, the last non-nuclear unit, John F. Kennedy, took just under four years; the Forrestal, prototype of modern carriers, took three. Under war urgency the slightly smaller Midway took two.

** That is, a hull stressed and balanced for the concentrated weight of a reactor would probably be poorly suited for the diffuse weights of more conventional plants, and vice versa.

torpedo hits.* One might also include under this heading very extensive pumping installations and fire mains. None of these weights is terribly useful in a merchant ship, or even in many classes of naval auxiliary. Hence we would have either to superimpose them on a merchant or auxiliary hull** or else dispense with a good part of them.

Certainly it would be preferable to try to build ships capable of surviving any level of battle damage; but that may be very difficult in an era of shaped-charge cruise missiles. As for underwater hits, if in fact submarines are more likely to be able to achieve hits with cruise missiles, there may be little point in the weight and volume expended on underwater protection; the primary mode of 'classical' underwater attack is likely to shift to under-the-keel weapons which directly attack the hull structure and which cause extensive shock damage. Armor is not useful against such weapons; in fact side armor tends to make their attack against the hull more effective by making the hull less flexible. If no level of armor provides enough protection, it may be wise to restrict our limited carrier to bare essentials: a thinly armored flight deck to prevent flight deck explosions from penetrating into the hangar; compartmentation (and dispersal of machinery) against underwater damage; some magazine armor; and of course a lot of fire fighting equipment.

All of this begs the question of carrier aircraft. The prime determinants of carrier size and cost seem to be the aircraft she embarks: the flight deck required to land the air group, the catapults which launch them, the hangars, the magazines for their ordnance, the tanks

* The armor comprises deck armor, which is most useful for confining the effects of explosions (e.g., USS Forrestal fire); some side armor as splinter protection against near misses; and the anti-torpedo and anti-mine system.

** Which even then would have to have unusual structural characteristics.

for their fuel. All of those considerations interact. For example, imagine that the carrier has as her primary mission anti-ship strikes. In the planning stage some estimate is made of how many sorties per day are to be flown and of how much ordnance / sortie is required.

A serious reduction in any of those quantities can sharply reduce the weights the carrier must provide. For example, in the anti-ship mission we can now provide a high hit probability with HARPOON or CONDOR; an aircraft with one or two missiles is likely to do as well as one with four or five times that weight invested in iron bombs. We can go further and use our explosives more effectively, so that one or two such hits can with fair probability kill the average Soviet warship. In that case the usual strike mission will require two or three thousand pounds of ordnance rather than ten or fourteen thousand. The weight can go into better speed, longer range--or it can be shaved away and a far smaller attack bomber (or VTOL) substituted for an A7 or a big fighter. Now the carrier shrinks. It needs a smaller flight deck, since the smaller attack plane can land more slowly, requires less spotting area, and can use a smaller catapult. Hangar decks can be smaller, and spare parts take up less volume. Magazines can be smaller and hence can be better protected on the same weight.

The next step down could come from a reduction in the number of sorties the carrier must be able to launch between replenishments. Once more magazine and fuel space can shrink.* As ordnance capacity is transferred to the fleet train, its importance increases and it becomes easy to justify "envelope" hulls for such units.

*As for fuel, additional volume might be saved by using JP5 for the ship's boilers. Then the ship could use her fuel for her own transit, and when on station devote more of it to flight operations. In such a case much would depend upon tankers and replenishment units. Here a conventional-fuel carrier is assumed.

This is not a cheap way out. By going to smaller aircraft we give up missions which require area bombardment; but it seems reasonable to ask whether there is ever a very great need for such attack, or whether we have merely used it in the past in the absence of any alternatives.* By going to a numerically larger fleet of 'universal-hull' carriers, cruisers, and AOE's we certainly raise our fuel and personnel costs--but we gain in protection against catastrophic failure. Most importantly, the increase in numbers, if it is coupled with effort in ECM and terminal defense, can frustrate the Soviet fleet strategy and raise their costs disproportionately.

A major gap remains. Smaller carriers will not be able to support the long-range fighters and early warning aircraft; and the S3s may have problems as well. For these vital tasks we must have large carriers; and the large carriers may as well have nuclear power in view of their size and consequent fuel needs.

In this discussion by "small" we mean 20,000 to 30,000 tons, not the 50,000 to 60,000 envisaged for the proposed "CVLN". The A4 was in fact designed to operate from 14,000 ton CVL's converted from cruiser hulls, and it seems a worthwhile question whether we cannot use the past two decades of airframe technology to get significantly more out of ships of this size. The first thing which comes to mind is VTOL, and indeed, if such examples of the new VTOL technology as the XFV 12 work out, we will be able to move towards extremely small carriers.

*For example landing support would seem a prime case for area bombings i.e., for large payloads. But the Marines seem very happy with their low-payload Harriers--which are able to fly off amphibious ships. On the other hand, it seems difficult to reduce ASW or fleet interceptor payloads.

The VTOL problem has always been the low payload lifted on takeoff, For example, the Harrier can take off at 18,000 lb. VT0 but a short roll raises this to 26,000. It seems relevant to observe that a catapult is equivalent to a take-off roll: a small catapult to the short roll of a STOL, a long one to CTOL. Now it becomes interesting to ask where the length of aircraft carrier flight decks originates. It turns out that a great part comes from the glide path and arresting gear; somewhat less from the big steam catapult.

Then imagine a VTOL aircraft rather more robust than is usual.* It normally takes off with the aid of a modest catapult--which need not be able to lift it unaided--at considerable overweight. It always lands vertically, ie., needs very little deck space. Because the airplane can take off ST0, it need not have a particularly powerful catapult. That fact can have a considerable impact on small-carrier design, because a small catapult can be both short and non-steam.

The latter seems trivial until one recalls that the abortive Sea Control Ship was to have had no catapult because it was to be gas-turbine propelled.** What is perhaps more rarely recalled is that hydraulic and, more interesting, internal combustion catapults have been developed in the past, the latter as an alternative to the present steam devices.

All of this is on the edge of possibility with current technology. Composites can strengthen VTOLs so that they can be catapult-launched; the new supercritical wings (as in AV-8B), can improve their payloads.

*To take catapult stresses.

**And standardization on gas turbines, which are essentially aircraft engines, would make sense from a spares and fuel point of view.

The "envelope" concept is more a matter of design policy and of discipline in interfacing than of anything else, although in fact it probably depends upon advances in electronics. That analysis we postpone for now.

If indeed we can make a more homogeneous--and more numerous--fleet practical, there will be tactical benefits most of which apply most strongly to exactly the "non-standard" war the Navy has most often actually fought.

Amphibious Forces

Since 1945 the thrust of amphibious force development has been towards a 20 knot force, for strategic mobility in an unstable world; then towards vertical envelopment, in part to improve upon the frontal assault by vulnerable landing craft, in part to permit operations on unsuitable beaches; and finally we have worked to enlarge the fast troop lift by moving towards much larger units such as the LHA.

At the same time we have given relatively little thought to fire support,* having had the luxury of large numbers of otherwise useless warships built for World War Two. A major naval force structure problem is that there are very important missions which can well be served by such 'low-end' ships. In fact we have had the 'high-low' mix for a long time, and it is our particular misfortune that we are now doing our best to dispose of the 'low' end. Nor is there any replacement clearly in sight. The 'low' end existed because the U.S. Navy more than doubled in every major category between 1941 and 1945, hence afterwards it was far

*Although the new 8"/55 MCLWG is sometimes cited in this regard. It may well be that air cover is regarded as a reasonable substitute; however, in that case we need more--and far more easily-replaced--carriers. Carriers tied to a beach are terribly vulnerable, and this vulnerability may increase as coast defense SSMS become more widely distributed. In that case the remarks on carriers are strengthened.

wiser to obtain 'new' ships by conversion rather than by new construction (e.g., CLGs, ASW destroyers). Unconverted units of relatively recent construction could then fill subsidiary roles. But now the remnants of that impressive program are thirty years old, and they are going to the breakers.*

The old destroyers represented a similar pool, but they too are going, and the fleet of fast escorts is being reduced to a point of bare sufficiency for carrier task groups only.

Were we to want to use amphibious forces extensively while the carriers faced serious opposition elsewhere we would need something more for fire support. Either we can buy some rocket so inexpensive that it can be used for area fire** or else that we can somehow marry the MCLWG in fair numbers to easily-procured hulls. Perhaps this is a case for MarAd features or for the "envelope"; certainly we do not want the expense of a fleet of heavy cruisers in peacetime--nor do we want the pain associated with their absence.

In fact the problem of amphibious operations goes much further. In nonstandard war we must consider not merely straight landings but also intervention to seal off coastal areas against enemy operations: interdiction. In Vietnam considerable forces were devoted to a coastal blockade (of the South) called MARKET TIME. The units required represent another major gap in the post-Vietnam fleet. One would once have

*Cruisers are a sobering example. The heavy cruisers were the primary fire support reserve of the Fleet. Twenty were built under the war programs. Of those, none is now in service. Five became missile cruisers (of which two retained some guns). Of the gun-armed ships, only the three last units remain in existence, but two of those have been in reserve for nearly fifteen years. All of the many pure-gun light cruisers are gone; two half-missile conversions remain in service with two more in reserve.

**Which did not look too economically attractive to the Army in its Mars study. But rockets do have the virtue of lesser impact on the ship design, hence may be less expensive in an overall sense. At one time LANCE was being considered for this role; but \$50 to \$100,000 is a very high price for the delivery, no matter how accurate, of a thousand pounds of HE.

called them 'gunboats'--high endurance, low-value units most capable of dealing with blockade runners. Until very recently there have been so many World War Two era units available that such operations as "Market Time" have posed no problems; but now we have scrapped most of the old DEs and DERs and there is no vast mothball fleet upon which to draw. On the other hand such units have little value except in rather specialized scenarios--in which they are terribly important--and represent a great upkeep and maintenance expense. They are, therefore, an unpopular category.

The units in question are basically coastal surveillance types. They are useful in situations of low threat blockade, e.g., in guerrilla warfare. It is nearly impossible to maintain a credible blockade without very large numbers of units to check merchant ships--as in "Market time." To some extent Coast Guard cutters can perform this function, but it seems unlikely that that service will always be willing to function as a live reserve for the Navy. Some means of maintaining the capacity to produce many units is needed as a replacement for the mothball fleet. Several possibilities present themselves.

One would be the 'envelope ship' route, in which a hull is designed for several tasks at least one of which requires continuous production. Such a hull is not optimal for any task, but serves fairly well for all--and is always available to be picked off the shelf. A candidate might be a 'universal light escort' which could be FF, FFG--or gunboat. Production might be maintained via overseas sales of replacements for the aging World War Two escorts in many navies; perhaps the basic hull could be adapted for auxiliary duties as well--but unfortunately there the trend has been up in size.

A second would be to assume that habitability at a relatively low speed would be satisfactory, and to use a standard MarAd hull. The only peacetime investment would be R&D and planning, plus some special features in subsidized construction. Indeed, this approach might be applied to a future mobilization escort. The trouble is that at present there is very little market for small or even moderate sized freighters; and no one can use a 30,000 ton 'coastal gunboat.'

Otherwise, we will have to hope that in any war requiring coastal interdiction we will not need escorts, and therefore that the rather expensive FF/FFG will be available.

A scenario which might illuminate these points would be a second Korean war. As of 1973 North Korea was credited with three ex-Soviet submarines as well as 14 missile armed patrol boats and about 40 torpedo boats. The South Korean army was considered superior to that of the North, the South Korean air force inferior. There is some probability that U.S. forces will be withdrawn from Korea within a decade. Presumably such withdrawal would be covered by a mutual defense agreement; and the Koreans might try to use their capability to produce nuclear weapons as a lever to make the agreement stick. One might also realistically envisage, in 1985, a Japan unwilling to have U.S. forces fly from Japanese bases (including Okinawa) into a war the North Koreans might term 'civil'.

If at that time the North Koreans try to move south, they may choose to use their air to try to neutralize South Korean airfields, then pin down South Korean ground forces on the DMZ while using merchant ships to end-run those forces. The merchant ships might be small junks difficult

to distinguish from normal coastal traffic. Depending upon their perceptions of the civil situation in the South, the North Koreans could try to infiltrate guerrillas to destroy South Korean materiel reserves, or they could try to establish coastal enclaves, perhaps to block South Korean ports. Light anti-ship missiles might be used to make such blockage more effective.

Such an invasion might well bring U.S. intervention--which in the first instance would mean carrier strike forces. The carriers would have to face and neutralize those missile boats while freighters brought in materiel to make up South Korean losses. The most intelligent use of the North Korean submarines* would be in trying to stop the merchant ships, which would then require sophisticated escorts or (see below) some self-protection. Assuming the latter technology has not yet been translated into hardware, the limited number of U.S. ASW escorts (FF) will be needed for escort duties in much of the Western Pacific--in fact the area which must be covered will expand as Soviet bloc and Chinese boats enter the area to confuse the picture.**

There remain the North Koreans on the southern coast. They can do real damage, but the South Koreans cannot afford to detach large ground forces for fear of diluting their force on the DMZ. If matters stabilize,

*This assumes that the submarines are using conventional torpedoes, in which case the carriers are difficult targets. But the submarines could also be used to mine ports. Yet a further complication would result if the North Koreans had access to a good torpedo-tube launched cruise missile such as HARPOON. Area ASW even against diesel submarines would be difficult in a region in which such 'neutral' submarines as Chinese and Soviet were operating.

**In fact both powers might find such 'assistance' most attractive, as they would be able to affect the outcome without engaging in clearly warlike acts.

the situation will call either for MARKET TIME or for an amphibious operation to dislodge those enclaves. The latter means some kind of fire support, especially if the North Koreans have SSMs and SAMs. And there will be the extra problem of those submarines, with much expensive shipping very nearly tied to the beaches.

Nor is this all. Were Korea the sole concern of the Navy, current forces might suffice. But a primary lesson of Vietnam was the vulnerability accepted by the United States if it tries to commit large forces to an essentially secondary theatre. Hence there is (i) pressure on the U.S. to raise forces without withdrawing them from other theatres; and (ii) an incentive for the Soviets to exert pressure in other areas so as to make it difficult for the U.S. to concentrate in the secondary theatre. (i) and (ii) add up to a scarcity of surplus U.S. carrier strike groups. The carriers cannot be risked for piddling gains while they are needed for the big war which is imminent in Europe or in the Middle East--or, for that matter, in the Indian Ocean. Nor can their fast escorts, or the Fleet Train.

In this scenario, war occurs with very little real strategic warning. Probably in hindsight some warning will be shown to exist, but in fact to act on it would mean to seem excessively nervous. For political reasons we prefer to think that war will not come, and therefore many rather deliberate assaults will seem to us surprise attacks.

Once war opens, events move very fast and there is very little time for refitting hulls or changing ships on the ways. Units already in existence must be used. But--there may be losses, and the steps described may ameliorate them. Certainly a greater use of VTOLs may make it possible,

in a pinch, for us to get some limited air cover out of such air-capable units as the new LHAs. And if in fact the fleet is more numerous, it is far easier to redistribute in crisis.

The Attack on Trade in Limited War

A major feature of the scenario presented above is the stream of merchant ships bearing material for South Korea, and hence subject to attack by North Korean forces. In theory modern ASW technology should permit our own forces to

(i) mine North Korean port approaches to prevent their submarines from entering submerged (e.g., using CAPTOR)

(ii) conduct area ASW operations in the sea around Korea to prevent attack on ships clearly headed for South Korean ports.

But the primary feature of nonstandard war is that the enemy can (and will) use political levers to make up for his technological or geographical inferiority. In particular, his submarines are relatively easy to detect and have poor endurance; and they must issue from a restricted set of ports. But on the other hand our own forces are designed to set up the ASW equivalent of a 'free fire zone' in the waters near Korea. It seems likely that in fact our forces would have to follow restrictive rules of engagement (ROE) which would effectively prevent them from attacking any but very obviously hostile submarines--i.e., submarines in the act of attacking.

Now, much of the progress in ASW since 1945 has been in the direction of increasing detection ranges and at the same time decreasing the time of flight of weapons fired at long-range contacts. In this way the number of ASW units can shrink as their efficiency improves.

Previously, it had often been the case that submarines were attacked only as they in turn attempted to attack merchant ships. The effect of realistic ROEs is then to turn the clock back to 1945. The ASW 'war' must now involve

--large numbers of merchant ships hit, if not sunk

--large convoy escort forces, with consequent drains on manpower and materiel

--restrictions on strike and amphibious operations, especially if the Soviets begin to use their fast attack submarines as 'tattletales.'^{*}

We should now pay much more attention to defending the merchant ships proper against submarine attack, i.e., to counter-torpedo devices (counter-mining and nets in particular).

Other classes of relevant naval technology would probably be (i) noise suppression (to make it perhaps more difficult for submarines to find targets even within their own designated 'free fire zones'); (ii) improvements in merchant ship survivability; and (iii) improvements in ship repairs. The latter seems at first a matter of trivia. But consider that merchant ships are constantly growing in size. A submarine carries only a few torpedoes, thirty at most. In typical actions, submarines have fired 'spreads' of as many as eight torpedoes at a time in hopes of making a few sinking hits. That meant that, unless he was rather lucky, a submarine commander could sink no more than six targets per war patrol. He would then return home, rearm, refit, and go back.

^{*}We now use a kind of free-fire doctrine around naval units; but that is likely to change in wartime.

But in the present scenario, the most hazardous part of the war patrol is the trip in and out of base. It pays to get the maximum effect out of each load of torpedoes. In particular, the submariner can elect to fire only one or two per target in the hope of causing damage requiring drydocking. This is particularly sensible if he has homing torpedoes.

Now the size of the ships enters. There are only so many very large drydocks in the Far East, only so many places torpedo damage can be attended to. When these are full, no more convoys can be sent out. Nor can we expect to replace damaged ships very easily--the greater size per ship also means a much reduced World merchant fleet (in numbers). Now it becomes terribly important for us to be able very rapidly to repair heavy hull damage in situ. That could mean a very sudden requirement for heavy repair ships--yet another function for the 'envelope hull.'

In this scenario, the submarines attack with relatively short-range torpedoes. Single hits are bad but generally do not sink the target; one can envisage hull patches put on under concrete caissons. The submarines must operate within a few thousand yards of their victims.

Present developments may change those realities. There is now little doubt that cruise missiles can be launched by submarines using their victims' propeller signature as targeting information; and such weapons, appropriately loaded, can achieve very extensive damage per hit.* Moreover, the missiles can be launched from impressive ranges which may frustrate conventional ASW screens.

At present only the U.S. and Soviet navies possess such weapons, and the Soviet version requires a specialized submarine. HARPOON is so

*So much so that the submarine operator can now choose between the value of sinking ships and the value of clogging repair facilities.

expensive as to be out of the reach of most of the minor navies. It seems likely, however, that France will soon develop its own underwater-launched missile and that it will find a wide market among the many small navies possessing diesel submarines. Probably the Soviets will feel compelled to produce a torpedo tube missile so as to extend the usefulness of their non-missile units.

Such a weapon requires merchant ships to have organic AAW defenses; and those defenses must be both cheap and simple to operate. One thinks at once of BPDMS and of CHAFFROC; it may also be relevant to recall that in the fifties the Mariner class cargo ships were designed to take platforms for ASW helos--or for the new class of VTOL fighters which then (1954) seemed in prospect.

But merchant AAW really seems to call for some kind of air capability--a big AEW radar and airborne missiles. Such a mission is the analog of the World War Two escort carrier role, and seems a natural function for an 'envelope' carrier with austere outfit, combined with HASP-A, the aerostat sensor package. Certainly there does not seem (to the writer) a very good chance of conducting limited ASW on submarines with thirty- or sixty-mile missiles, since:

--Assuming we can be sure of seeing all submarines within a sixty mile radius,

--We cannot be sure they are hostile, short of watching them fire;
And even then

--We would have to keep station above every contact, an exhausting procedure particularly vulnerable to decoying.

Some kind of ultra long range automatic ASW ICBM might simplify matters, but only marginally.*

Submarines are not the only threat merchant traffic will face. Shore based SSMS are likely to be increasingly available to minor powers and even to insurgents; and they can be used both as coast defense and as blockade weapons. A scenario may be illuminating. Throughout the Arab world, national wealth equals oil equals tanker traffic. Two countries confronting each other--e.g., Iran and Saudi Arabia--may well find tanker attack far more attractive than attack on the source of the wealth, i.e., the oil ports and the refineries and wells.

The U.S. may well find itself in the position of a neutral miserably watching a war erode its own oil imports. Any U.S. unilateral action to end the war (so as to protect oil imports) will tend to cause postwar problems, and hence U.S. action is likely to be delayed or perhaps prevented. The technological question is then whether the anti-tanker weapons can somehow be neutralized via some ECM or AAW or anti-torpedo measure aboard the tankers.

Nor need the confrontation be in the Middle East. All the narrow international straits present the possibility of anti-shipping action by missile. The missiles embody many of the characteristics of the big coast defense guns which every nation used to buy, except that (i) they cost far less especially in terms of likely hits per unit ammunition cost, i.e., in total money expended per hit; (ii) they are mobile, hence may be hard to knock out; (iii) their fixed costs are very low. It actually

* See "Nonstandard War at Sea," HI-2140-DP.

becomes attractive for outfits like the PLO to threaten to block straits and then look for ransom; and the age of the Barbary pirates may once more be with us. A key difference is that intervention is not always popular. It may be even less popular if we face the loss of a significant part of our amphibious lift in the process.* The character of our naval forces changes significantly if every minor engagement carries serious risks, made more serious by necessarily very restrictive ROEs.

The 'conventional' trade protection operation of the Korean scenario requires above all escorts and CVE-equivalents.** It highlights our more usual obsession, in ASW, with defence of the fast carrier strike forces. Thus we often class SSNs as ASW units, but in fact we think of them either as fleet escorts or as anti-SSBN. We have given up the specialized ASW carriers in favor of integrating ASW and strike functions--but one doubts that the CVNs will be used as day to day convoy escorts. Surely their sophistication is not required for such a function. But we no longer have the luxury of a reserve of ex-fleet carriers (Essex class) to use for ASW support. In fact what was lost when we lost the CVS was the option of providing heavy ASW to a secondary theatre without having

* Another consequence of the numerical shrinkage of our fleet. There will be only five LHAs.

** I.e., carriers dedicated largely or entirely to the ASW mission--and available in numbers. CVEs were built on merchant hulls, and passed out of service as they became incapable of handling advanced ASW aircraft. Their replacements in the ASW role were the big CVSs, converted fleet carriers--an example of the use of the World War Two ship pool for secondary tasks. Even so, the CVSs were too few in number for convoy operations, and were used mainly to screen fast carrier formations. Ultimately the old CVSs wore out, and the CVA and CVS functions were merged as the big carriers were redesignated 'CV.'

to commit a major strike unit. And matters become bleaker as we contract our attack carrier forces.

We have the problem of the convoy escorts just as we have the 'gun-boat' problem. The more stringent the ROEs, the closer in the escorts must be, and the more that are needed. Once more there is a case for some kind of 'universal light warship' fitted out in varying degrees of complexity. Technological questions include ease of mass production via, perhaps, commonality--for example, commonality with aircraft powerplants--and via numerically-controlled manufacture. It may become worthwhile for us to think more about the hydrodynamics of hulls built out of flat plates, as in some particularly economic foreign merchant ships.*

Above all, we want to avoid building, in peacetime, a large reserve of ships; and yet to be able, in a pinch, to replace losses and battle damaged ships quickly enough for us not to shrink from action for fear of foreclosing later actions. This is not quite the 'mobilization war' design we have discussed elsewhere, but in many ways it is closely related.

The Role of Exotic Hull Forms

The notes above amount to a prescription for a change in degree of the Navy's shipbuilding orientation; but no radical change is envisaged. However, there exist several very different hull types which may in future alter the shape of the U.S. fleet: surface-effect ships (SES), small-waterplane hulls (SWATH), hydrofoils. These types share several interesting qualities:

* Such construction might also contribute to ease of repair after hull damage.

- (i) High sustained speed, even in high sea states
- (ii) Heavy power loading per ton, i.e., low payload
- (iii) Great cost per ton
- (iv) In some important ways, very much lower vulnerability to underwater hits
- (v) Light construction and hence low survivability in the face of above-water damage.*

Without an extensive analysis, we can make a few comments concerning the relation of these qualities to the kind of war we have described. One perception of future naval technology would be that sooner or later conventional naval weapons will be so lethal that a kill, given one hit, will be inevitable. In that case we must hope to live either by numbers or by very effective terminal defense, which latter at first blush would tend to oppose the former (AEGIS will not fit in a PT-boat). However, better micro-electronics and reliable data links (laser?) may make it possible to distribute a system like AEGIS over a great number of moderately large units.** In that case the stability afforded by hydrofoils might turn out to be very important.

A particularly interesting point here is that it has long been appreciated that the most efficient way to use explosives against warships is to explode them under the keel. But against hydrofoils and SES this is not a very lethal mechanism at all. On the other hand, such units would probably succumb easily to more conventional forms of attack.

*This point is less applicable to the very stable SWATH.

**The rub might then be magazine capacity, which argues the importance of advances in missile propulsion and warhead lethality.

The other major advantage of SES is such high speed that it attains a kind of strategic mobility as compared to conventional systems. An SES fleet provides the closest naval approach to quick reaction forces. For example, a 100 knot SES can transit the Atlantic in about 36 hours; a 30 knot CV would require about 120. Then if the rather noisy SES can survive its transit, it can be used to alter the strength of the Sixth Fleet within a time perhaps too short for Soviet units to form concentrations against it; but on the other hand the SES, if it is caught, will not survive very long. Hence the SES might prove useful in precisely those periods of non-war tension which have been so characteristic of the post-World War Two period.

Yet another unusual naval weapon is the large seaplane. In the 'fifties the Navy developed a big seaplane, the P6M, for strategic attack on the periphery of the Soviet/Chinese heartland. Unlike carrier attack aircraft, P6Ms could operate out of any moderately sheltered cove, and it was hoped to use special submarines to fuel them. Presumably a major hope was that the seaplanes could force the Soviets to disperse their air defense forces; they would have to counter both the SAC bombers, the location of which they knew, and the mobile carrier aircraft. P6M was ultimately cancelled to free funds for POLARIS. In a reincarnation, such aircraft might be used for anti-ship recce/strike, providing deep-ocean coverage from constantly shifting 'bases' and thus discouraging Soviet attempts to cancel out our own current landbased air (P3s).

IV. U.S. VS. SOVIET STYLE IN FLEET DOCTRINE

A fleet is the physical expression of a sequence of tactical and strategic ideas. The greater the cohesion of those ideas, the more consistent their physical expression, the more efficiently can the fleet carry out its intended mission. It follows that a clear and correct perception of our opponents' concepts can make more practical a counter to their fleet. A perception of the concepts inherent in the structure of our own fleet may guide us more effectively as we seek to modernize.

In strategic terms the builder of a fleet has two basic choices in his use of the sea. He can attempt to use it as a highway (force projection), which implies sea control in wartime; or he can opt for the simpler goal of preventing his enemies from so using it. Historically, in most cases the latter goal has proven unattainable by itself; real sea denial has generally entailed the establishment of sea control. However, in the context of U.S.-Soviet naval rivalry it is well to keep in mind that whereas the Western Alliance is held together by the sea, the primary Soviet motive for sea power has been a desire to protect the maritime approaches of the Soviet Union.

This relation need not be immutable. The modern U.S. Navy began as a coast defense force, fortunately cast in what we shall see is the form most suitable for sea control. The Soviets, with no intrinsic need for deep sea control, have made a substantial investment in merchant ships. They are beginning to try to project their power overseas, which means that ultimately they must try to achieve sea control. Even at present, coastal shipping is of considerable importance to the Soviet economy.

However, at present it seems possible usefully to characterize the main U.S. and Soviet Naval investments in coherent tactical and strategic terms, and to use those paradigms to seek effective counters to the Soviet naval threat.

In particular it makes sense to think of the Soviet fleet as the expression of the ideas of one man, Admiral Gorshkov. In our own case the direction is harder to perceive because overlaying it is the four-year cycle of CNO's and planning staffs. However, for many decades the basis of our naval philosophy has been the battle fleet idea.

Much of the coherence of our own fleet organization is a consequence of the continuity of doctrine-making bodies such as the General Board in the period prior to World War Two. This is by no means to suggest that the basic doctrine is in any way obsolete. One reason our fleet doctrine has been less cohesive since 1945 than before is that the fleet mission was better defined before 1945: the defeat of Japan. Since V-J Day the role of all U.S. forces has become more diffuse (or complex). A major tension in naval doctrine since 1945 has been a conflict between the strategic bombardment mission (e.g., *Polaris*) and the older sea-control mission.

Another important element of the postwar Navy has been ASW, which before 1939 was not regarded as worthy of large specialized efforts. One might describe the conflict between carrier task force and ASW advocates as one between force projection and sea control, in a period in which the Soviet fleet was almost entirely a submarine threat, and one unlikely to be able to menace the fast carriers. Thus the early frigates, which were at one time designated "Fast Task Force Escorts," were optimized for AAW at the expense of ASW capability. Emblematic of this situation was the

abandonment of most airborne anti-surface ship weapons. The emergence of large Soviet surface forces returns the big carriers to a sea control role. Indeed, the Soviet missile-armed surface ship/submarine forces are most logically answered by the composite air groups of the CVs.

In what follows we will pass over this (temporary) contradiction.

The U.S. Sea Control Force

Thus, our Navy achieves a concentration of offensive power in the form of a few very powerful units (capital ships)--be they battleships or aircraft carriers. Such ships are very expensive, but their great size implies great flexibility, as well as a high level of active and passive protection against enemy attack. The loss of a single unit is a severe blow, but on the other hand, serious problems of command and control are obviated. Much of the flexibility of the Fleet lies in the broad choice of the weapons it can launch, because of greater magazine space and available top weight. One might say that it takes a big ship to launch anything as flexible as a reusable naval attack aircraft. The durability of the big units is associated with a strategy of command of the seas; it takes endurance and flexibility and the ability to absorb attack to maintain a naval presence in wartime.

To support our capital units we have built up a screen of lighter units, essentially (at present) platforms for AAW/ASW weapons and sensors. In principle it should be possible to build a fairly inexpensive screen, since the screening units do not have offensive missions; but since 1945 the increasing dispersion of the Fleet and the speed of incoming weapons have combined to require greater and greater AAW ranges. This in turn means AAW weapons and sensors of great size and complexity--hence great

weight and cost--so that the cloud of screening vessels shrinks down to a few CGNs each costing a large fraction of a capital ship.

Soviet Sea Denial Forces

The Soviet alternative is a mass of essentially undifferentiated light expendable units of no great individual staying power. Effort is concentrated in their single purpose (anti-capital ship)* weapon and in the command-and-control system which enables them to strike the big enemy units in such a coordinated manner as to break through passive and active defenses. A fleet of this type depends upon a pre-emptive strike. It can deny the sea to its adversary, but only on a one-time basis. The tactics associated with this "sea-denial" fleet are by nature inflexible. They demand dispersal (since the light units are individually vulnerable) and then coordinated firing of sophisticated weapons from maximum range. Anything which upsets the timing destroys the concentration and permits the battle fleet to survive the attack and reply effectively.

The pre-emptive strike in turn depends upon timely targeting information. Now, in peacetime it is not hard for the Soviets to trail our major units operating within range of their fleet, so that if they choose to do so, they can set up some kind of coordinated strike upon the outbreak of war. Clearly their "tattletale" will not survive that instant, and equally clearly it will have little relevance to our forces not already in the operational area by that time. Hence the great significance of sea surveillance. At present this means long-range aircraft, but such platforms cannot be satisfactory if the Soviet Fleet is to be used at any

* Actually anti-major strategic ship, since this includes anti-SLBM. See below.

great distance from its land bases. Shadowing and targeting may be important functions of the new Soviet air-capable ship. Her very heavy defensive armament, achieved at the expense of aircraft performance (i.e., arresting gear, catapults, deck space)* suggests that, like the elements of the Soviet offensive force, she is intended to operate as a solitary unit. We assume that for the near term real time sea surveillance by satellite is not practical in view of the data rate required and in view of the potential for decoying. Submarines could achieve some measure of surveillance via their passive sonars, but we would argue that too many would be required and that they would be too easy to decoy. The primary sea surveillance platform would have to be an airborne (manned) one.

In its current form the Soviet sea-denial force consists of cruise missile-armed surface ships, maritime bombers, and submarines. The missiles are necessary to ensure hits on fast well-screened capital ships; for example, it is very difficult even now for a submarine to be sure of hitting a fast carrier--which in any case can absorb a considerable number of torpedoes.** As the Soviets operate further from their land bases, they

* These considerations would seem to militate against a strike role: VSTOL aircraft are notoriously poor weight-lifters, and the Soviets use rather large anti-ship missiles. However, it is possible to envisage a valuable reconnaissance function, coupled perhaps with some measure of defense against U.S. strike forces. It may also be that the Soviets are not optimistic as to the viability of their big MR aircraft once war has begun.

The VTOL fighters might also be used to counter U.S. MR aircraft (P3, S3) which we regard as essential to clear lanes for our own carrier strike forces.

** The diesel submarines built in very great numbers from about 1950 on are probably not so much connected with serious sea denial as with Stalin's perception of the near-success of the U-boats in 1939-45. It is worth remembering that in 1941 the Soviets had by far the largest submarine fleet in the world. From the point of view of interfering

must come to rely entirely on the combination of ship and submarine missile launchers.* An important characteristic of this fleet is that it can fire only a single salvo: the size of the individual missiles precludes reloads. On the other hand, the tactic of saturating ASMD demands not only that each ship fire all of her missiles but also that the entire force fire together. In effect the Soviet fleet disarms itself every time it carries out its principal tactic. Hence its commanders must have a special fear of decoying, which means that they will be disinclined to shoot at inconclusive contacts.** On a smaller scale the commander of every detached Soviet missile submarine faces this problem. He almost has to fire everything, but that means that he can hope to make no more than one or two attacks per war patrol. This is not to mention the fact that the act of firing gives away his own position and hence may materially shorten his patrol.

with fast warships, a torpedo armed diesel submarine is not too useful: it has little underwater mobility and its primary weapon has a low probability of hitting a fast target. Even a snorkel does not change matters fundamentally, since a snorkeling boat is both loud and visible to specialized radars. Nuclear power confers a mobility comparable with surface ships and cruise missiles provide a serious anti-surface ship capability.

Presumably in wartime the diesel submarines would try by their numbers to block the sea approaches to the Soviet Union, using air reconnaissance to make up for their immobility; but it can be argued that that is a poor use of resources.

One suspects that only after the demise of Stalin and the perfection of the earliest cruise missiles did the concept of an integrated sea-denial fleet take form.

*The latter are far harder to kill, but at the same time they present much more serious communications problems.

**As we shall see below, to fire partial salvos is to reduce too dramatically the chance of success. A carrier is essentially different in that her aircraft are not a one-time asset; the same might be said of a fleet designed for easy and rapid rearming at sea--as the Soviets are not. At the least, a prerequisite for them would be the development of substantially smaller anti-ship missiles, the appearance of which might be an indication of a switch from sea denial tactics.

Sea Denial and Platform Costs

The sea denial fleet is the usual vehicle employed by inexperienced naval powers to overthrow established fleets--as, presently, in the case of the Soviets vs. the United States.* Its key attraction is that the individual platforms are relatively cheap compared to the weapons they launch. Hence the force of platforms can be built up very rapidly, even if in fact the weapons they are supposed to fire are not quite ready; for no opponent can bank on that (unknown--unknowable) level of readiness. As the platforms increase in sophistication and in size relative to their weapons, the implicit strategy passes from one-shot sea denial to sea control; ** this is also the transition from a relatively cheap fleet to an expensive formation which must be provided with elaborate means for its own preservation. The primary costs of the system shift from weapons plus command-and-control to platforms and the means for their presentation. The latter are inherently higher costs, but we would argue that they buy far greater flexibility. The total cost of sea denial may even exceed

* Also, e.g., the Japanese vs. U.S.N. and the French vs. the British circa 1890. An interesting example of a sea denial fleet is the German U-boat arm of World War Two. The U-boat was largely invisible until it approached and attacked its targets, at which time the concentrated ASW forces could counterattack. Classic U-boat tactics against these local concentrations called for a simultaneous attack from many bearings so as to dilute the attentions of the convoy escort. The chief obstacle to effective attacks was always command and control; command was exercised by the Commander, U-Boats, from a base ashore. There is a striking analogy here with the way Soviet sea-denial forces are controlled, not from a flagship but from Navy HQ ashore. It seems suggestive that a principal element in the defeat of the U-boats was radio direction-finding, which (in effect) attacked the concentration point of the dispersed U-boat fleet, its communication net. Another was the signals from Commander, U-Boats, to his fleet, which messages, broken, reflected the deadly effect of centralized control.

** In the Soviet case this transition would have to involve extensive provision of reload missiles and hence far larger ships.

the total cost of the sea control force. The key distinction is that the fragmented sea denial force can be built up incrementally, and presents a serious threat even at a low level of development: one Kresta has a small (though finite) chance of killing a carrier, but a carrier built up to the engine room level in the building dock at Newport News cannot sink the Kresta. On the other hand, after five years or so the carrier is more effective than (say) the five Krestas she costs; and this does not begin to count in the expense of missiles and command/control/targeting, or the need for more trained personnel per ton in a fleet of smaller ships. This disparity in the continuity with which effective naval power is built up is reflected in the effect of the loss of a single unit: one Kresta costs the Soviets far less, sunk, than one CVAN costs us. But as long as a CVAN is many times harder to kill (from a passive point of view) this comparison is not a significant one. Matters become more interesting if we pass to a nuclear scenario (sure kill if the weapon hits) and a total absence of ASMD.

Historically the greatest problem in naval warfare has been command and control. For example, historians often fault the British commander at Jutland, Jellicoe, for his adherence to exhaustive and rigid Fighting Instructions in 1914-1916, which tended to suppress personal initiative among his subordinates. What Jellicoe really saw was a confusion of smoke and shell splashes in which he might as easily lose capital ships by misadventure as by enemy action.* In such circumstances the individual unit

*The unwieldiness of capital ships made loss by collision a serious proposition. In peacetime exercises during the Nineteenth and Twentieth Centuries, quite a number of such accidents have occurred, e.g., the recent loss of the U.S. destroyer Frank E. Evans to the Australian aircraft carrier Melbourne in night maneuvers, June, 1969. Two British battle cruisers, Australia and New Zealand, missed the Battle of Jutland because they had collided in fog over a month earlier. Jellicoe himself very narrowly missed drowning as a result of a peacetime collision which resulted in the loss of the flagship of the Mediterranean Fleet, HMS Victoria, in 1893.

must be powerful enough to make a substantial contribution to the battle on its own; it must survive minor breakdowns in tactical communications; and yet it must be amenable to cooperation with its sister units.

But it is very expensive to build capital ships. It is always possible to visualize weapons which can, in favorable circumstances, destroy such ships and which can be fired by very much cheaper craft.* The classical example of such a weapon was the torpedo. This device could, at least in theory, be fired by craft the size of a cabin cruiser--from short range. Anyone who wanted a reliable sea-denial capability against

*"Very much cheaper" often has to imply a self-propelled missile, since otherwise there would be problems associated with the missile launcher, e.g., recoil in a naval gun. Even some missiles make heavy demands. Thus, aircraft were originally thought of in this category of cheap weapons; many early advocates of carriers believed that one or two 15,000 ton carriers could massacre a fleet of 35,000 ton battleships--as happened in a few instances. However, as aircraft developed, the inexpensive carriers became impractical; and even the smaller ones could not be produced in such numbers as to be considered expendable. Quite soon the combination of air group requirements and demands for extensive passive protection drove carrier displacements past those of the battleships. For example, in 1932, the U.S. Navy regarded the 20,000 ton Yorktown as very nearly optimum. Ten years later the standard was more than a third larger (Essex, 27,500 tons) and the minimum for worthwhile passive protection (Midway, 45,000 tons) larger yet. The reason this kind of growth paid was the flexibility of the manned airplane. The carrier commander could control his Air Group by having strike pilots briefed face to face; he had no command and control problem once the strike was launched. In contrast a missile has the basic inflexibility of any automated system. The missile is relatively easy to launch because it can sustain a high g-load upon takeoff and because it does not have to accommodate a life-support system (weight advantage). However, the possibility of catastrophic loss of main battery to ECM/ASMD suggests that it is not too profitable to build a missile-armed "battle fleet." We would add that even the missile makes considerable demands in terms of sea-keeping and control apparatus.

a battle fleet would have to buy a great many torpedoes and torpedo boats, so as to guard against low reliability and countermeasures.* His launch platforms would have to be relatively cheap craft.** These rather vulnerable torpedo boats would have to attack from as many bearings as possible, or else face the concentrated fire of the battle line. Such a coordinated attack would in turn make severe demands upon command and control--or else demand an extremely rigid plan.

*"Reliability" would include the question of the seaworthiness of the cheap torpedo craft. Countermeasures included weapons to attack both launch platforms and missiles. Expressed in these terms, the various doctrinal and technical issues of the 'nineties are hard to distinguish from current ones. Anti-missile countermeasures have a particularly striking effect when each platform carries only a very few weapons. A typical Soviet missile ship carries no more than four or eight SSM's. Four hits might be required for a kill (cf. Elath). Now, to get at least four hits out of eight shots 94 percent of the time, the eight-shot Soviet ship has to maintain an individual hit probability of about 70 percent. Anything which cuts this figure very much dramatically increases the number of platforms required: for example, at an individual hit probability of 20 percent, eight missiles have only a 59 percent chance of scoring any hits at all. Matters improve considerably as the number of missiles goes up, i.e., as the size of the launch platform increases. A salvo of twenty 20 percent weapons has a 59 percent chance of achieving four or more hits and is virtually certain of achieving at least one. Recent work which improves greatly the lethality of relatively small warheads would tend to favor the construction of missile armed "capital ships" with large magazine capacities, as such capacities could be attained within reasonable dimensions. In such a case the ASM's begin to look more like the shells of classical naval guns and less like torpedoes.

Another way to make this comparison would be to allocate system cost between platform and individual missile. The larger ship can, of course, accommodate better ASMD. However, the inherent inflexibility of the ASM always remains.

** This was the usual pattern. A remarkable exception was the U.S. Navy's idea of a capital ship armed with torpedoes, i.e., a torpedo battleship. This concept received extensive war-game study between 1907 and 1911. What killed it was the calculation that the gun--the weapon of the larger platform--could keep it out of torpedo range. In effect this says that the switch from sea senial fleet to battle fleet using a new weapon is impractical until the new weapon is superior to the conventional battle fleet weapon. Then the question of missiles vs. naval aircraft for our (battle) fleet resolves into the question of the effective range (ECM immunity, perhaps) of one or the other.

In fact the surface torpedo sea denial force would probably fail in practice. What it would give its owner would be a serious and sobering threat against the owner of an expensive battle fleet. The latter could never rely on the failure of planning or communications, especially in the standard "worst case" of a pre-emptive torpedo strike.*

It does not seem so very far fetched to exchange Soviet anti-ship missiles for the old French torpedoes. The rub is still command-and-control, and despite all the glories of modern electronics, that is still a very great rub. It is the element absolutely essential to any sea-denial force; it is the element we can preferentially attack--as the Soviets preferentially strike at our sine qua non, our capital units. And it is the can of worms we open if we attempt to move from a dimly perceived battle fleet doctrine to a Gorshkov-like sea-denial doctrine. It did not take the French very long to appreciate that even the best of naval missiles (torpedoes) did not represent a short cut to sea power; it should not take us--or the Soviets--so very long to appreciate the same thing now.**

*For example, a common scenario before 1914 was a mass night torpedo attack on a fleet anchorage at the outbreak of war. The British moved their Grand Fleet to Scapa Flow at least partly to prevent such a strike. In fact the Japanese tried it in 1904 at Port Arthur, but failed largely because of the inadequate lethality of their torpedoes--which goes to show that a sea denial force can be a lot more impressive before it makes its big pre-emptive attack. Of course, the great adherents of the torpedo were the French, and in the 'nineties a series of French naval propagandists wrote future war novels in which British naval supremacy was broken by mass attacks. It was fitting that the most successful of these writers assiduously avoided actual cruises in the uncomfortable boats of which they wrote.

**Which is not to denigrate the missiles in their place. The battle fleets did have torpedo craft in attendance; missiles are a very useful adjunct.

U.S. submarines in the Pacific were able to perform some sea denial in the absence of extensive C² by operating at natural concentration points of Japanese shipping. However, we would argue that it was a combination of low Japanese shipbuilding capacity and the strain applied by U.S. sea control forces which made the submarine campaign so effective. For example, the Japanese showed little prewar interest in ASW, partly because they had to spend so much to achieve surface sea control.

"Effective command and control" is not a particularly evocative phrase. What it really means in this case is flexibility. The fewer the units, the closer together, the easier for a very few individuals on the spot to react to unforeseen circumstances. In tactical situations this flexibility is the most important thing lacking in a sea-denial fleet.* Allied with command-and-control is of course targeting or sea surveillance. In the case of the carriers, much of the targeting mechanism is incorporated in the strike force; but in the sea denial (missile-oriented) fleet special provision must always be made for surveillance. The extra targeting mechanism only adds to the burden on command and control.

An Historical Example of Sea Denial in Action

Probably the most interesting historical example of sea-denial in practice is provided by the Japanese Navy of World War Two. Nominally the Japanese subscribed to the same battle fleet philosophy as did their opponents, the Americans. However, for many years prior to 1941 they had been precluded by treaty from building a battle fleet comparable to that of the United States. The standard combat theories of the time suggested that an engagement between the U.S. and Japanese battle fleets must end in a Japanese disaster--unless the U.S. fleet was shaved down to

* One might say that one reason is that once the self-guided missiles are on the way, there is not much chance of replying to an enemy's altered dispositions. We would suggest that the problem is a deeper one related to the absolute necessity for close coordination among elements of the sea-denial force.

parity first.* Such a theoretical conclusion was tantamount to a shift in priority towards the sea-denial preliminary engagement. In order to fight this primary battle the Japanese developed the most sophisticated cruise missile of their time, an extraordinary powerful torpedo ("Long Lance").**

The battle line disparity could be taken to mean that any Japanese naval concentration would be vulnerable to the (unattrited) U.S. fleet.

* A common theory assumed that combat effect was proportional to the square of the number of equivalent units. The London Treaty (1930) allowed the Japanese 9 capital ships to 15 American units--a ratio of 2.78 even were the U.S. ships counted equivalent to Japanese (an optimistic assumption for the Japanese). The destruction of four U.S. ships before the main battle, i.e., before any Japanese main fleet losses, would cut the ratio to 1.23, a more acceptable risk. An interesting aspect of this "square law" is that it assumes a high degree of coordination among units which may be lacking in a dispersed sea-denial force.

** Their preferred tactics were pure sea-denial: destroyers bearing "Long Lances" would appear at night, fire their missiles and then retire before the targets could realize that they were under attack; clearly this had to be a very well coordinated strike, and it must have taken a lot of faith in the missile to release it for its half-hour run. The missile was specially designed to resist detection: an oxygen propellant was adopted to ensure wakelessness, despite the increased handling hazard it represented. The acceptance of such a vulnerability to catastrophic damage would be in line with the image of a sea denial fleet as a collection of minor expendable units. The important surveillance/targeting function was to be carried out by seaplanes carried aboard fast tenders and aboard the cruisers accompanying the destroyers; the cruisers also carried torpedoes. So important were the aircraft that in some Japanese heavy cruisers gun armament was displaced by them. Probably the classic Japanese torpedo strikes were their night attacks on U.S. cruisers off Guadalcanal. These tactics were finally countered when reliable radar sets were issued to U.S. ships; now the Japanese could be detected as they launched, and counter-maneuvers initiated after the torpedoes had already locked onto their (fixed) courses. Radar also, of course, permitted effective shellfire.

The "Long Lance" was not the sole Japanese sea-denial measure. For example, midget submarines were developed for launch at sea. Before World War Two the U.S. Navy also regarded as Japanese sea-denial measures long-range (land based) torpedo bombers, a force of which sank the Repulse and Prince of Wales; minelayers; and some of the unusually large Japanese submarines.

It would be better to avoid entirely large concentrations until after the primary engagement; the valuable fleet could better be broken down into subgroups, the loss of any one of which would not be fatal. The classic Japanese strategy envisaged the concentration of these subgroups upon the attrited U.S. Battle Fleet.*

By a peculiar twist of fate in 1942 the Japanese fleet was actually far stronger than was ours. But habits of thought--especially ones for which the basic reason is no longer perceived--are hard to discard. So at Midway we see in the Japanese plans what seems to us an inexplicable failure to concentrate forces. We also see in the Japanese commander, Yamamoto, psychological collapse under the success of what we can honestly call only a spoiling attack. We see the same pattern two years later in the Leyte battles, with different commanders. Often this pattern has been described as typically Japanese. It is not. It is, we would argue, the inevitable result of a sea-denial strategy.

On a personal level, the sea-denial strategy requires the suppression of initiative in the individual ship commander. It is best for him to fit into a plan worked out by a single overall commander; for that plan is likely to be quite fragile, quite vulnerable to "spoiling"--either by timely attack or by misplaced elan on the subordinate's part. This kind of denial of initiative is often ascribed to Communist political philosophy; but in fact it seems inevitable in any sea-denial

* An alternative was to keep the Japanese Battle Fleet concentrated in protected (Home) waters until after the battle of attrition. The choice between a sea-denial fleet at sea and one in port awaiting the arrival of the U.S. main fleet corresponds to a choice of forward vs. home port deployment for the Soviet Fleet.

strategy of the Soviet type. It is precisely in this vulnerability to "spoiling" blows that our great opportunity lies. The Soviet fleet can be so spread out that even were its ships to be made of paper it would be a very difficult task to sink all of them before their missiles were off. What cannot be spread out is the communications net absolutely essential to that rigidly planned strike.

Post-1945 Strategic Considerations

All of these considerations involve only the classical naval goals of domination or denial of sea lines of communication. Since 1945 another element has been added in the form of naval strategic attack. In fact it is often argued that the original goal of Soviet cruise missile ship construction was the destruction of the U.S. strategic carrier threat. On this basis the goal of the Soviets was still the destruction of the U.S. capital ships, although the underlying reasoning was new. The carriers were still capital ships because of their dual strategic/anti-ship capability. On the other hand, the SSBNs are not; they are purely strategic weapons--unless there are some very big changes in targeting, not the least of them technological.

In fact the emergence of U.S. submarines as a serious strategic target for the Soviet fleet must have put a serious strain on their resources. Although a fast carrier task force is endowed with numerous defensive weapons, it can at least be seen with fair certainty by current sensors. That is not the case with an SSBN, at least with one operating quietly.

In recent years the Soviets have taken to designating their principal surface units as ASW ships. It is not clear whether this reflects a

realization that some organizational reply to the SSBN is in order, i.e., that the money spent to counter carriers had better be applicable to the carriers' successors; or whether there is some expectation that the ASW sensor picture will soon come to resemble the surface-surveillance picture; or, finally, whether the Soviets expect ultimately to trail SSBN's as they do carriers. Certainly their ASW differs from ours in that ours is primarily oriented to the defense of formations of surface ships, not to strategic ends.

An important point here is that the Soviet Fleet is very poorly equipped for ship to ship coordination. Moreover, the Soviets may very reasonably expect our attack carrier forces to shield our SSBN's by striking any concentrated ASW task forces they may form. Hence it seems unlikely that they will be interested in the Hunter-Killer groups so long a standard part of USN practice. All of this means that their strategic ASW practice is probably conceptually similar to their anti-carrier practice: targeting by airborne or seaborne sensors external to the attack units, followed by long range (probably nuclear) bombardment by missile. In fact the main distinction between CVAN and SSBN is a lack of potential terminal defense in the latter case.

Because of their large and flexible magazine capacities, the carriers can easily combine their strategic and sea control roles. It is tempting for the user of sea denial forces to attempt to attain a similar flexibility; he can, after all, use a nuclear rather than an HE warhead for his cruise missiles. However, the low ratio of missiles to platforms has

unfortunate consequences for him.* In fact the low ratio of missiles to platforms must constantly impel the sea-denial operator to press the lethality of his individual missiles, e.g., to accept and even to prefer tactical nuclear warfare. But such an orientation on the part of the Soviet navy need not indicate a willingness on the part of the Soviet government to release nuclear weapons so as to achieve victory in what might consider a peripheral conflict. But in any protracted conventional battle, the small size of the individual platform must militate against adequate self-protection, i.e., against staying power.

Special Characteristics and Vulnerabilities of the Sea Denial Force

i) Superior sea surveillance. Otherwise it may be spotted (i.e., destroyed) before it can strike. The only alternative is for the sea denial force to assure its first strike by deciding always to initiate war. Such an assumption might not be tenable in limited warfare. For example, it might be a viable escalation of a limited Central European war for the Sixth fleet to make a preemptive strike on Soviet Mediterranean forces, without local provocation. In a tactical sense the sea denial fleet is as destabilizing a force as is a field of soft ICBM's in the strategic sense.

* For example, say the 8 missile ship carries 6 HE and 2 nuclear missiles. Then its chance of scoring four or more hits with 70 percent missiles is only 74 percent. Reliability would require that at least two missiles be nuclear; flexibility, that the maximum number be HE. The assumption is that there exist no below-decks arrangements for warhead replacement, etc: to achieve any kind of useful missile load in a small hull the sea-denial operator must dispense with reload arrangements. In effect the Soviets must build ships the way they do unless they are willing to add many thousands of tons to achieve marginal improvements. Their only alternative would be to scale down their missiles.

Once war begins, the sea-denial force is effective only as long as its targeting/surveillance component survives. Thus an effective counter to Soviet long-range naval forces would be an offensive against the big MR aircraft.

ii) Very efficient command and control. This system must include continuous status reporting of individual units. Otherwise the fleet commander cannot assume that his fleet is ready to fire. As the complexity of fire-control gear increases (and its reliability decreases) this status reportage becomes more vital. It may be that the communications gear is the most appropriate target for radiation-seeking missiles. If the presence of these missiles tends to deter communication, the sea-denial fleet is in serious straits.

iii) Maximum numbers, to maximize the dispersal of the fleet. Dispersal means both survivability of individual units and saturation of our terminal defenses. Hence the most logical constructional strategy is austerity and very little defensive armament. However, the sea denial strategy is not so very well appreciated that its proponents will accept ships armed solely with big cruise missiles. Shipyard constraints may also tend to restrict somewhat the number of units. Of course, in a situation of limited resources, as the numbers rise so does the difficulty of command/control. Manning and shipyard costs also rise out of proportion to the number

of weapons deployed; and the more austere the ships, the less durable they are.* Pure sea-denial may have more charm in theory than in practice.

iv) Separation of the fleet commander from the zone of operations. There can be no unit the loss of which would destroy the cohesion of the dispersed force--i.e., there can be no fleet flagship in any serious sense. For example, Soviet "flagships" perform administrative tasks only. To the extent, however, that the Soviets wish to operate their ships in tactical combination, they must provide local tactical commanders, hence back away from the dispersal their basic strategy requires. If in fact the air-capable ships are the key to shadowing/targeting in Soviet operations far from home, they present exactly this type of target. The same can be said of the big MR aircraft based in places like Cuba and Somalia: kill the aircraft and the missile ships find it hard to operate.

v) The serious sea-denial force must forego any geographical concentration which makes it a tempting target for a pre-emptive strike. As tension increases the ships must disperse: they cannot present neutrals with an image of increasingly concentrated strength. Soviet behavior in 1973 may bear out this contention.

*Austerity is also counter-productive in a Navy intended for its peacetime political clout: it is hard for the natives to gape at a cabin cruiser, even if their rulers know that the cabin cruiser has aboard a gizmo which can (perhaps) sink a carrier. That is why so few submarines have ever been used to "show the flag." The Soviets have not tended to use their most impressive units for port visits; however, one can consider the function of their Mediterranean Fleet a kind of "showing the flag." It is possible that the Politburo buys ships in direct proportion to how strong an impression they produce on it: ships are over-armed because the ministers want a lot of rockets for their rubles. Early U.S. capital ships were over-armed (for their size) for very similar reasons.

Some Future Prospects

It seems generally agreed that the Soviet Navy is trying to expand its operational area well beyond the Soviet coastal seas. Should that Fleet try to maintain its sea denial strategy, a serious problem may soon confront it: replenishment.

Operations far from home require either well-stocked foreign bases or mobile bases in the form of replenishment ships, or else very considerable sacrifices in the form of space and weight to improve endurance.

Foreign bases represent a considerable investment as well as a point of concentration attractive to attack. As the Soviets have shown, such bases are vulnerable to peacetime political assaults as well. Even worse, the maintenance of a string of bases forces upon the Soviet Navy the role of sea controller.

The basic problem of replenishment ships is that they pay only if one ship can top off several warships. In that case the replenishment ships can be concentrated and thus protected; but that requires a concentrated fleet. Otherwise it is one (say AOR) auxiliary per combatant, and the costs are brutal for even a small sea denial fleet.

An alternative which the Soviets may have adopted is a very large fleet of auxiliaries which pays for itself in peacetime as a big merchant fleet. Once more the problem is that the individual units are easy to sink--easier in fact than the warships they service, and just as rewarding--and far less efficient than specialized auxiliaries. Alternatively, merchant ships caught in ports upon the outbreak of war might be used for replenishment--as the Germans did in 1914 and in 1939. However, factors militating against such a strategy would have to include neutrals' discomfort at the use of their ports as bases; the special fuel required by

Soviet gas turbine warships; and reloads for missile tubes, which are large and bulky loads. The latter would matter more as the fleet moved away from its cloud of MR aircraft and hence toward easier decoying.

The Soviets are left with the choice of warships of individually great endurance. That seems to mean both nuclear power and large capacity for stores and reloads (at least reloads for defensive weapons) and consequently high unit cost. As the number of major units multiplies, the cost becomes worse and worse, yet there is no good sea-denial alternative to nuclear power; indeed, nuclear power is far more essential to such a force than it is to our task forces. It is ironic that a force designed specifically to consist only of cheap expendable units ends up instead with only the most expensive ones.

One suspects, then, that for long-range operations the Soviets will have to abandon their centralized system in favor of flagships, task groups, and all the impedimenta we sometimes try to eliminate. And that will mean that there will be prime Soviet targets just as valuable as are our CVN's.

Sea denial has its limits.

V. SATELLITES AND SEA CONTROL

Much of the utility of artificial satellites is contained in the statement that they provide an extraordinary vantage point--an artificial star by which to navigate (one observable by many), a collector and disseminator of information (telsat, recce satellite, ESM device) to cite three examples. In warfare the significance of the satellite might be comparable to the degree to which its overview corresponds to the area of the theatre of operations. In general the area of satellite overview is so great that it seems essential only for strategic operations, and satellites are characterized as adjuncts of strategic warfare.

However, there is one variety of obviously non-strategic war involving distances which can only be encompassed by satellite systems. That is naval warfare. Where a movement of 70 miles would be a remarkable day's work on land, at sea even a slow (10-knot) force moves 240 nautical miles in the same period. Fast units may move three times as far; a commander can, in effect, call on forces over an area of many millions of square miles for a single engagement. Conversely, a force commander expecting attack must be aware of enemy dispositions and of climatic and sea conditions (i.e., sonar and aircraft-launching conditions) over a similar area.

Much of this data can be gathered most efficiently by tactical sea-surveillance satellites. Similarly, force control might most efficiently be done via satellites, as individual units could speak to the satellite via highly directional channels which would be less useful to enemy direction finding than would be classical low-frequency radio. Precision navigation

is also very important in this model of naval warfare: too bad if the recce has found the enemy, but the force dispatched to strike goes to the wrong position!*

This, too, is best done by satellite.

Under those circumstances the elimination of certain specialized enemy satellite systems becomes a matter of some tactical urgency for both sides. However, a peculiarity of the asymmetry of U.S. and Soviet fleet structures is that, although the United States often seems to depend more heavily on satellites for many of its operations, in fact the Soviet satellites are more essential. Hence, it may be in our interest to consider a tactical antisatellite capability useful or even vital as a naval asset.

The character of the Soviet fleet is determined by its primary mission: the defeat of U.S. seaborne strategic forces. At first, inspired by German successes in two World Wars, the Soviets tried to achieve this end (which in 1945-60 meant the defeat of fast carrier task forces) by constructing very large numbers of submarines. The submarines suffered, however, from a lack of information. In order to avoid detection by passive sonar, they had to avoid high speeds, i.e., were essentially static. They could be effective only if they were predisposed athwart likely carrier approach lanes, and even then their chances of hitting high-speed targets were poor.**

*As happened to several U.S. submarines in the Pacific War. More exactly, the boats were sent to points the Japanese heavy units were supposed to pass, according to radio intercepts; but Japanese navigation was faulty.

**Largely a consequence of the low ratio of torpedo to target speeds, coupled with the relatively short range of the torpedo.

The next development was a long-range cruise missile. This had the great charm of low unit cost in exchange for considerable threat. Missiles could be fired by a wide variety of platforms: surface ships of relatively small size, long range bombers, later submarines.* All that was needed was some accurate idea of where the enemy was. That could be provided by long-range patrol aircraft, "tattletales," and--most reliably--specialized satellites.

It turned out that the missiles had one primary defect. Since they could be spoofed or even shot down, there was a critical number, dependent upon the character of the target, required to saturate defenses. The existence of this critical-number phenomenon demanded that some means of coordination be provided among the many means of launching missiles.

Another problem was that most of the Soviet platforms had enough missiles for one, or at best two, salvoes. The missiles were too big for reloads to be carried. Hence the Soviets had to be very sure that the 'target' found by their recce devices was the real thing, since a salvo fired in error would disarm them. The problem was intensified by the fact that their naval forces were all controlled by central agencies on land. The decision to fire would fall to someone seeing a variety of somewhat ambiguous reports. The penalty for ragged fire would be survival of the (U.S.) target and, according to the Soviet interpretation of U.S. doctrine, possible strategic attack by U.S. carrier aircraft; thus, both targeting and control--both at least partly satellite functions--were considered essential by the Soviets.

*Which could now hope to hit fast carriers.

On the American side, the recce force was integral with the fleet, in the form of carrier-based aircraft. The penalty for an erroneously dispatched strike was no more than that aircraft would return to fly off again. It would be useful to know where the Soviets were, especially useful to have advance warning of a strike--but much of that could come from American carrier aircraft, not least because the carrier was the Soviets' target. That is, the carrier always knows that it need search only within the range of the Soviet missiles; its primary role of strategic strike requires no great independent targeting capacity.

That is not to say that the carrier commander is free of the need for timely ocean-wide surveillance. He would like very much to sense enemy dispositions so far in advance as to allow him to avoid them, or at least so far in advance as to allow his own long-range strike to pre-empt.

The carrier commander (or the commander of a convoy) also requires a timely knowledge of ocean conditions over a wide area. He wants to steer a course most favorable to his own weapons (aircraft) and sensors (sonar, radar). The former require particular sea state conditions for launch and recovery. Sonar is particularly environment-dependent for its operation, since sound propagation in the sea is affected strongly by factors such as temperature gradient, sea state, and salinity. Even search radar shows quirky behavior in some thermal conditions. And sea state determines how fast a force can move, how easily ships can fuel at sea, even how tired their crews will be. The carrier commander or convoy Commodore has to get from here to there with relatively little emphasis on just how--and to see just how, he would like a good environmental map of a whole ocean.

Soviet missile tactics suggest another significant use for a U.S. sea-surveillance satellite system. In principle a submarine launching a cruise missile discloses its position via the IR plume of the missile. A system of sea-surveillance satellites can monitor the IR plumes and direct long range ASW missiles toward their origins. The net effect of such a system, which in fact may not be terribly effective, is to bias submarine commanders against firing unless they are very certain that they are not being decoyed. Once more this biases the Soviets towards elaborate sea-surveillance systems.

It is true that in normal circumstances an individual submarine can hope to detect high-value targets via her passive sonar at a range of about a hundred miles. However, passive sonar is subject to decoying--potentially with fatal results against the submarine. Therefore an effective cruise-missile submarine force requires the assistance of further targeting agencies, which in turn require considerable two-way subsurface-to-air/satellite communication, once more with potentially unfortunate consequences for the submarine.

In the end the entire Soviet naval force becomes critically dependent upon accurate targeting data because of the high cost of erroneous attacks. C³ is also of critical significance.

In 1975 the Soviets can no longer view the big carriers as the primary U.S. means of seaborne strategic attack. They acknowledge the change to SSBNs partly by redesignating their big surface cruise-missile ships "large ASW vessels." However, strategic ASW demands some kind of wide-area search mechanism, either developed or seriously in prospect; at the least it demands some mechanism which can force the SSBNs to remain below

launch depth. The area character of this task suggests the use of satellites--if in fact any remote-sensing ASW system is practical. Certainly an IR plume-detector would be invaluable against U.S. SSBNs employed in a limited-option or limited tactical strike role.*

A secondary Soviet consideration is likely to be the use of our carriers to shield SSBN operating areas from their "large ASW vessels." Hence the carriers, even if they do not constitute a primary U.S. strategic attack force, must be destroyed if the Soviets are to be able to neutralize the SSBN force. Once more the satellite system is of prime importance.

In the end, the Soviet concept of naval operations comes to depend critically upon centralized targeting and C³--upon satellite functions. For us satellites are very useful, but they are essentially a luxury.

*Other alternatives might include large sonobuoy fields monitored by satellite, or some kind of laser scanner intended to force submarines down. Uncertainty on the part of U.S. forces, if the Soviet devices were properly and subtly publicized, would greatly enhance this "pindown" effect. If the precise character of a Soviet open-ocean ASW system were unclear, it would be particularly difficult either to assess its efficiency or to assess counter-satellite kills.

An interesting consequence of Soviet deployment of effective satellite ASW sensors would be disclosure to the West. The Soviet submarine fleet at present is by far the largest in the world, hence any wide-area ASW sensor is most effective against the Soviets in the tactical role. In effect, by trying to solve a strategic ASW problem, the Soviets disclose a development which destroys the efficacy of their tactical submarine fleet--which in any case presents severe C³ problems in cruise-missile warfare. If the ocean is like glass, why accept those problems at all? Hence if the "large ASW ships" go along with ASW satellites, we can expect a decline in Soviet tactical submarines, beginning about when they expect Western intelligence to confirm the character of their system--certainly by 1980. This argument may also explain the range of the missile carried by the "Delta"--the new Soviet SSBNs can remain in shallow Soviet coastal waters while they fire.

In particular, we depend upon simpler satellites--navigational aids and oceanographic devices--than do the Soviets, which may make ours easier to replace or easier to harden against likely anti-satellite weapons.* Hence it would seem that the adoption by both sides of anti-satellite warfare would favor the U.S., at least insofar as naval operations are concerned.

A particularly interesting possibility is attack by fleets at sea against low-flying active radar, oceanographic, or ESM satellites. It seems likely that current long-range SAMs such as Standard (ER) can be modified to destroy big satellites with small explosive charges or pellets; after all, the missile ought to be able to trade extreme maneuverability and some guidance for better altitude performance. It is already common for parameters of 100,000 feet (20 miles altitude) and sixty or eighty miles' range to be cited. How much harder is 150 miles up and zero range?

Satellite attack is a particularly attractive U.S. pre-emptive option in a near-war scenario. It is one of the few attacks in which no neutral lives can easily be lost through mischance; and it generates far less emotional reaction than does a first strike on Soviet ships. Yet, if our considerations are correct, it can have the consequence of quietly disarming the Soviet fleet.

*In particular, navigation need not demand an active satellite. And communication can be via "needles" which are impossible to destroy.